Summary of Progress *of the* GEOLOGICAL SURVEY OF GREAT BRITAIN *and the* Museum of Practical Geology for the Year 1931

PART I

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Summary of Progress

of the

Geological Survey of Great Britain

and the

Museum of Practical Geology

for the Year 1931

PART I

With Report of the Geological Survey Board and Report of the Director

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REPORT OF THE GEOLOGICAL SURVEY BOARD FOR 1931

TO THE LORDS OF THE COMMITTEE OF THE PRIVY COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

MAY IT PLEASE YOUR LORDSHIPS.—

In accordance with our terms of reference, we, the Geological Survey Board, beg to submit our Twelfth Annual Report on the work of the Survey and Museum.

Accommodation (London)

It is gratifying to report that rapid progress is being made with the building of the new Museum and Survey Offices at South Kensington. It appears reasonably certain that before the end of another year the transfer of the Jermyn Street offices, library and collections will be imminent.

Proposals for the exhibition of the collections in the new Museum are referred to in a later paragraph of this Report.

Accommodation (Scottish and Provincial Offices)

The additional store rooms which, as mentioned in our last Report, were being built in Edinburgh as an annexe to the Survey Offices have been finished, and the collections of fossils and rocks have been transferred to them. This not only provides greatly improved accommodation for the collections, but also makes possible the rearrangement of the library and the map series in the office building.

The branch offices at Manchester, Newcastle-on-Tyne, and York are being maintained.

Field Work

The Director's Report for 1931, which is submitted herewith, shows that satisfactory progress was made with the programme of field work for the year.

The Field Units were engaged in the undermentioned districts:—

Southern District (primary six-inch survey).
West Midlands and Biggleswade (primary six-inch survey).
Yorkshire District (revision of six-inch survey).
Lancashire District (revision of six-inch survey).
Cumbrian District (revision of six-inch survey).

Northumberland and Durham District (revision of six-inch survey).
West Highland District (primary six-inch survey).
Shetland (primary six-inch survey).

The urgent need for financial economy last autumn caused the field season to be brought to a close about two months earlier than usual. This curtailment of the field work effected a considerable saving in travelling expenses. Although the abridgement of the field work prevented the completion of the programme for the year, we are satisfied that it has not been detrimental to the general efficiency of the service. Compensating advantages were provided by the opportunity of overtaking certain indoor arrears in publication work and the freeing of some Survey officers for the important task of preparing collections for exhibition in the new Museum.

Details of the work carried out by each of the Field Units mentioned above are given in the *Summary of Progress* (pp. 39-63).

Publications

The year under review has seen steady progress in the publication of maps, memoirs and vertical sections of strata, and the amount of matter in the press at the close of the year was unusually large.

In England two new quarter-inch maps, one one-inch map, and twenty-nine six-inch maps have been published; while in Scotland one quarter-inch map, four one-inch maps, and eighteen six-inch maps have appeared. Three English Vertical Sections of Strata and one Scottish Section have also been issued.

Noteworthy among the memoirs published during the year are those on the Whitehaven and Workington District, Manchester and the South-East Lancashire Coalfield, Wells and Springs of Leicestershire, the Economic Geology of the Fife Coalfields (Area I), and the Geology of Central Sutherland. A memoir containing Chemical Analyses of Igneous Rocks, Metamorphic Rocks and Minerals, compiled from the records of the Geological Survey, has also been published.

Arrangement of Collections in the New Museum

The general plans for the arrangement of collections and the display of exhibits in the new Museum are fully explained in the Director's Report (pp. 6-9).

It is proposed to regard the Museum as composed of two parts, one open to the general public and the other reserved for research students and specialists. The public part will be the main floor, the first, and second galleries.

The main floor will contain exhibits illustrating general principles of geology, such as are likely to appeal to members of the general public who have no special knowledge of geological science. It is proposed to demonstrate such subjects as weather-

ing, scenery, caverns, river action, volcanoes, earthquakes, extinct animals, precious stones, marbles, etc., with an abundant supply of maps, models, and photographs.

The first gallery is intended to represent the regional geology of Great Britain. For this purpose the country has been divided into sixteen geological districts. These regional exhibits will include rocks, fossils, maps, diagrams, models, and photographs, and there will be an illustrated explanatory handbook to each exhibit.

The second gallery will illustrate the practical applications of geology and the uses to which rocks and minerals are put in the industrial world. Such subjects as building stones, clays, cements, slates, iron ores and the ores of other metals, oil fields, and abrasives will be illustrated.

On the top floor, which will be reserved for research students and specialists, the collections will be arranged in four series—palaeontological, petrographical, mineralogical, and palaeobotanical. This floor will contain all the best material not already exhibited in the open part of the Museum and will be accessible to geologists who wish to examine the Survey's registered collections.

Inspection of Bores and Shafts

The Board are glad to learn that the powers conferred on the Geological Survey under the Mining Industry Act of 1926 have continued to prove of high value, and that no difficulty has been experienced in the working of this Section of the Act. Ready facilities for the examination of cores and for acquiring information have been given by mining companies, engineers, and shaft sinkers.

Many bores for water have also been inspected by permission of the parties concerned.

Details concerning the visits of inspection made by the Geological Survey officers can be gathered from the Director's Report.

Co-operation on Soil Surveys

The Geological Survey has continued to render assistance to the Soil Surveyors both in England and in Scotland. The Soils Correlation Committee (see our Eleventh Report, p. 3) made two tours in England and on both of these a geologist was detailed to render assistance to the Committee. In Scotland assistance in the South Ayrshire district has been continued and a special one-inch map of this area showing the physical characters of the soils is being engraved for publication in addition to the usual " solid " and " drift " editions of the geological sheet.

Investigation of Building Stones

Progress in this investigation with the Building Research Station has been continued. Further close collecting from the

beds of building stone at one of the localities has been carried out in order to confirm certain conclusions.

Suspension of Geophysical Work

We think it desirable to refer to the suspension of geophysical work by the staff of the Survey and Museum. It was becoming more and more difficult for two of the principal officers employed on geophysical investigations to spare time for this work in view of the impending removal of the Museum to the new building. For this reason, and for others as set out in the Director's Report (p. 23), we have agreed to temporary suspension of geophysical work, and to the loan of the Survey's apparatus to the new School of Geophysics at the Imperial College of Science and Technology.

Membership of Geological Survey Board

In accordance with the arrangements governing the retirement of members of the Geological Survey Board the undermentioned members retire from service on the Board at the end of March, 1932 :—

Sir Henry G. Lyons,
Professor P. G. H. Boswell, and
E. O. Forster Brown, Esq.

Programme of Field Work

The programme of field work for 1932 is :—

(*a*) primary mapping on the six-inch scale in the south-east of England (Sevenoaks, Biggleswade, Bridport), in the West Midlands (Droitwich and Dudley), in Shetland, and in Inverness-shire ;

(*b*) revision of original six-inch mapping in the following coalfields and adjacent areas :— Lancashire (Wigan and Preston), Yorkshire (Barnsley and Wakefield), Cumberland (Cockermouth and Gosforth), Northumberland (Morpeth, Tynemouth and Elsdon), Dumfriesshire (Sanquhar) and Fife (Kirkcaldy and Anstruther) ;

(*c*) investigation of underground water-supplies, examination of mineral resources, verification of bore records, investigation of sources of building-stones, and collaboration with soil-surveys.

As a result of the rapid progress of the building of the new Museum, and in view of the necessity for financial economy, the field programmes will be less extensive than hitherto, in order that satisfactory progress may be made in preparations for the transfer to the new building.

T. Franklin Sibly,
Chairman.

30*th March*, 1932.

SUMMARY OF PROGRESS OF THE GEOLOGICAL SURVEY AND MUSEUM FOR 1931

I.—REPORT OF THE DIRECTOR

THE programme of work undertaken by the Geological Survey in 1931 was spread over a very large number of districts in England and in Scotland, and in spite of somewhat unfavourable weather conditions considerable progress was made. Towards the close of the field season it became evident that there was a probability of overspending the financial grants, and partly on this account, partly from an attempt to restrict expenditure and provide savings at the close of the financial year, the field season was brought to a close at an earlier date than usual. This procedure was approved by the Department of Scientific and Industrial Research as a step rendered advisable by the stringent programme of economy enjoined on all Government services. Consequently, except in certain districts where it was important that work should be prosecuted without delay, and for certain urgent services such as inspection and economic enquiries, travelling was stopped as nearly as possible on the 1st October and the staff withdrawn from the field to the branch offices and district headquarters.

Fortunately this abridgement of field work could be carried out without detriment to the general efficiency of the service; in fact under existing conditions it provided a means of overtaking certain important tasks which were incumbent on the staff. The additional time thus rendered available for office work in the preparation of maps and memoirs and the detailed and often elaborate investigations which are necessary before publication can be made has enabled the staff to wipe out arrears and will really accelerate publication.

In Scotland particularly there are still several memoirs to be written and printed on the economic geology of the coalfields and on certain maps which have been published or will soon be published. Some of these are in the press; others are more or less completed in manuscript, while others have yet to be written. The shortening of field programmes will hasten the completion of these literary and cartographic tasks, and as it is undesirable that too long an interval should elapse between survey and publication of the results the abbreviation of the field season is by no means disadvantageous. In England publication of both maps and memoirs is nearly abreast of the field survey but there are many demands on the time of the field staff which it is impossible to ignore.

The rapid progress that is being made with the building of the new Museum of Practical Geology at South Kensington makes it

reasonably certain that before the end of another year the transfer of offices, library and collections will be imminent. The architect reports that he is well satisfied with the progress made by the contractors, and though the details of the transfer cannot yet be definitely arranged and no dates can yet be fixed, it is already incumbent on the staff of the Geological Survey to face the preliminary operations. Consequently it has been advantageous to be able to withdraw officers from the field at an earlier period than was usual in former years because it is only by the assistance of the field staff that it will be possible to make the preparations for removal within a reasonable time. By the end of the year the office work entailed on the English field staff to ensure the prompt publication of maps and memoirs that were nearly ready for engraving and printing had been in large measure completed, and it was possible to divert the activities of a number of geologists to museum work. The work has been divided up into sections, to each of which a number of geologists has been allotted, acting under the general superintendence of the Curator and certain District Geologists.

Although during the year 1931 the programmes of field work have not been much reduced by the necessity of getting ready for transfer to the new Museum it is probable that in 1932 this will be carried much further. With the approval of the Geological Survey Board it has been decided that the claims of museum work are so important that field work in certain districts will be considerably restricted. Such of the younger members of the staff as have received training in the duties of Museum officers will be employed for a large part of the year in arranging the collections in the Museum for packing and transfer and in designing and selecting specimens for exhibit in the cases of the new Museum. This work requires experience and training which can be only slowly acquired as the duties are totally different from those of field surveyors, and it is necessary that the work should be carried out continuously and without interruption if satisfactory progress is to result. Already a good start has been made and progress is becoming more rapid with increased familiarity with the work. A serious disadvantage is the very restricted space available in the present Museum, which in addition to being absolutely filled with the collections made by the Survey during a period which amounts almost to a century, is obstructed by the temporary erections that were necessary to support the structure and is darkened by the removal of the panes of glass in the roof. Much of the material that has been selected for exhibition in the new Museum has been packed away in boxes after it has been labelled and catalogued, as all the empty space on the Museum floors is required for the assembling of further exhibits. It is extremely probable that during the coming year the upper floor of the Museum may have to be closed, except to scientific enquirers who wish to consult the collections, in order to furnish working space for the officers engaged on the new exhibits. It will probably be possible to keep the ground floor open to the public

and to give free access to the library, map room and albums of geological photographs.

Although it has not yet been possible to make a definite allocation of space in the new Museum, and although most of the exhibits are still in an embryonic state, it has proved advisable to sketch out the main lines which will be followed, leaving the details to be filled in at a later stage. A Committee has been appointed consisting of experienced museum officers, the petrographer, palaeontologist and a representative of the field staff, and all programmes are fully discussed before action is decided on. It has been agreed that the new Museum will not be in any sense a replica of the present Museum. Much of the material now exhibited will be made use of, but the general arrangement and plan of the exhibits will be of a different kind. A large amount of new material is being collected both by the auxiliary staff and the geologists. A special campaign of photography has been put in hand as it is intended to make use of photographs on a generous scale to demonstrate the typical scenery of British geological provinces and the special characters of their rocks. Coloured panoramic views and paintings to show the landscapes of former geological epochs are being designed, and much attention is given to accuracy in geological and palaeontological detail in these restorations of bygone ages. Scale models of districts which show interesting geological structures are being made both in the Survey workshops and by artists employed for the purpose. A large number of new diagrams, sketch-maps and sections is being prepared to serve as explanatory matter for the specimens to be shown in the cases. During the coming summer the collectors will be busy in the field securing the specimens needed for new exhibits and taking photographs in districts from which at present we do not have satisfactory negatives. In all cases such work must be carried on under the superintendence of officers of the geological staff who are familiar with the local geology and are able to select the best material to illustrate the essential features of the district.

In general it is intended to regard the Museum as composed of two parts, one for the use of the public and open at all the ordinary Museum hours, the other reserved for students and specialists who wish to use the collections for scientific research or for verification of published statements. The whole top floor of the Museum, which has a superficial area of 16,000 square feet, and is admirably lighted, will be devoted to reserve and study collections. These will be arranged in four series, palaeontological, petrographical, mineralogical and palaeobotanical, each under the custody of an experienced and highly trained specialist. This collection will contain all the best material which is not already exhibited in the open part of the Museum. Access to this gallery will be free to geologists who are making researches and wish to consult the Survey's collections. The registered fossils and rocks that are referred to in Survey Memoirs and other publications will be in this gallery and at once available to visitors who wish to inspect them. It is

probable also that working accommodation for visiting specialists will be provided, so that the new Museum will be a centre of research which gives every facility to specialists to make the fullest possible use of the materials relating to British geology that the Survey has accumulated during the past century.

The main floor and first and second galleries of the new Museum will be open to the public at the usual hours. It is intended to devote each of them to a different purpose so that all the exhibits on one level will be part of a general plan that embraces the whole Museum.

The main floor or ground level will contain material illustrating the general principles of geology and a few of its most interesting applications, such as are likely to attract the attention of members of the general public who have no special knowledge of geological science. There will be a demonstration of such subjects as weathering, scenery, volcanoes, earthquakes, caverns, river action, extinct animals, precious stones, marbles, with an abundant supply of maps, models and photographs. The geology of London and the adjacent country will receive special attention; and, if possible, room will be found for an exhibition of the work of various departments of the Geological Survey and the different types of its publications.

The first gallery is intended to represent the regional geology of Great Britain. For this purpose the country has been divided into 16 districts, each of which forms a more or less simple and natural geological unit. Each district has been allocated to an experienced officer who is familiar with its geology, and he has drafted a brief report expounding the characteristic features of the district, which will serve as a guide to the topics that have to be illustrated in the corresponding part of the gallery. Specimens are now being chosen from those in the present Museum, and lists are being prepared of additional specimens that will be required to make the exhibits representative and satisfactory. These lists will serve as guides to the collectors who are to go to the field in search of them in the summer season. Each main division of this gallery will illustrate a distinct part of the British Isles by means of rocks, fossils, maps, diagrams, models and photographs, and it is intended to issue an illustrated handbook explanatory of the exhibit. In this way a student of geology will obtain a clear conception of the distribution of the various geological formations in Great Britain, the essential characteristics of their rocks and fossils, the geological structures and the types of scenery which are most frequent. The display will thus have a regional basis, though also to a large extent arranged according to successive geological periods, and the fossils and rocks will be used to exemplify the epochs of British geological history and the provinces in which their deposits play an important part. In the adjacent Natural History Museum the biological relations of the fossil animals and plants and the mineralogical characters of the rocks are displayed on a magnificent scale, but in the Museum of

Practical Geology the classification will be stratigraphical and regional, so that the two series of exhibits will supplement one another.

The second gallery or third level of the Museum will illustrate the practical applications of geology and the uses to which rocks and minerals are put in the industrial world. Such subjects as building stones, clays, cements, slates, iron ores, oil fields, the ores of the metals, abrasives, will be illustrated by specimens, models and maps. Wherever possible, British materials and industries will be used for purposes of illustration, but in certain cases, such as diamonds, gold and manganese, where there are few or no British sources of supply, the materials exhibited will, as in the present Museum, be taken by preference from British Dominions and Colonies. Many of these exhibits will have special reference to the series of Special Reports on British Economic Resources, of which thirty-one volumes have now been published, and to other economic memoirs of the Geological Survey.

Field Work

In London and the South-east of England the re-survey of the Sevenoaks Sheet (287) has been carried on in continuation of the work now finished in the Reigate Sheet (286). This has proved excellent training ground for some of the young geologists recently recruited to the service. The Reigate map is being engraved and will be published in a few months, and the descriptive memoir has been nearly completed in manuscript. Towards the close of the year a beginning was made with a revision of the six-inch maps of London. The last survey was done about thirty years ago, and much new information has been acquired since then in the course of building and draining operations, in boring for deep wells and in widening and improving the streets and roads. The surveying and engineering departments of the London County Council have collected a vast amount of details regarding the superficial geology of the London area, and have placed their records at the disposal of the Geological Survey in the most helpful manner. A good deal of this information is confidential and cannot be given to the public unless with the consent of parties who are interested, but it is extremely useful in enabling the geologists to fix the position of boundary lines for the various types of subsoil and superficial deposits, and will greatly increase the accuracy of the new maps.

The great value of the ground and the density of the population in the London area make it worth while to collect all particulars regarding the substratum. It is now intended to publish a set of geological maps of London on the scale of six inches to the mile. Hitherto such maps existed only in manuscript form in the library of the Geological Survey, where they could be consulted by architects, engineers and others who desired to obtain the fullest data regarding London geology. These maps have been much used by enquirers, and it is believed that if published in a colour-

printed edition at a popular price they will meet the needs of a wide public. Mr. Dewey and his staff of geologists have spent much time in the latter part of 1931, after the close of the field season, in drafting the manuscript copies of a new set of geological sheets of London, and it is expected that about a dozen of these will be ready to go to the engraver early in 1932. They will contain very much more detail than any geological maps of London that have ever been published. The only six-inch maps of British cities that have been issued by the Geological Survey are of those districts where workable coal deposits exist within the city boundaries, such as Manchester, Glasgow, Newcastle. These were issued either uncoloured or hand-coloured; the London maps will be colour-printed.

After the completion of the manuscript of a new edition of the Torquay memoir (Sheet 350) Mr. Lloyd was transferred to Bridport in order to revise that Sheet (327) on the six-inch scale. He has made a start with this work, but has been incapacitated for a period by ill-health. The work will be continued during the coming field season. It may be necessary also to prepare a new edition of the Sidmouth Sheet (326), of which the stock is nearly sold out. This district, with the adjacent coast of Lyme Regis, is a favourite hunting ground for geologists interested in the study of Jurassic rocks.

In the East of England attention has been centred on the district around Cambridge, of which the geological maps are seriously needing revision and the addition of new information. Work was begun in the Saffron Walden area (Sheet 205) several years ago and the map has been brought up to date by the survey of the superficial deposits by Mr. Edmunds and Mr. Dines. A memoir has been prepared by Mr. Osborne White, with contributions from Mr. Edmunds. The new map and memoir are in the press and should be published in a few months. Many interesting discoveries have been made regarding the Pleistocene deposits in that ground. The work has been continued by Mr. Dixon and Dr. Sherlock in the adjacent Sheet to the west (Biggleswade, 204), and considerable progress has been made. As Cambridge stands at the corner of four New Series Sheets it will be necessary to continue the revision to the north in Sheets 187 and 188 (Huntingdon and Cambridge), but at present work is confined to the Biggleswade Sheet.

The officers engaged in the revision of the West Midlands coalfields are at present concerned in three Sheets, Shrewsbury (152), Dudley (167) and Droitwich (182). The re-survey of Shrewsbury is finished and the map is engraving; the memoir is nearly completed in manuscript. The Dudley Sheet has not yet been completely revised, though not much remains to be done in it. The Droitwich Sheet has only been commenced. This will complete the revision of the Forest of Wyre Coalfield, the last of the West Midland fields to be examined, leaving the Forest of Dean and Bristol and Somerset coalfields for future programmes.

During the past year, at the request of the officers of the Forestry Commission, a careful examination of part of the Forest of Dean was made by Mr. E. E. L. Dixon, who furnished a report to serve as a guide to the soil conditions of a considerable area in which a reafforestation scheme was under consideration.

No field work was done in 1931 in the second revision of the South Wales Coalfield. Dr. Robertson, who was engaged in this work, has been transferred to Scotland. He has, however, been passing through the press a number of revised editions of six-inch South Wales Coalfield maps, and has also superintended the publication of a revised one-inch Sheet, Abergavenny (232), which is now published to accompany his memoir on that district. A revised edition of the Merthyr Tydfil memoir has also been prepared by Dr. Robertson, and was nearly ready for the press at the end of the year. Several other South Wales memoirs are sold out, but the task of preparing new editions cannot at present be undertaken till other more urgent work is finished.

In Yorkshire, Mr. Bromehead, with his staff of four geologists, has been busy in the re-survey of the Wakefield (78) and Barnsley (87) Sheets, which consist mainly of coalfield, of great importance industrially, and with rather complicated geological structure. A careful study of the geology of Leeds has been made during the course of the year and was much aided by the friendly co-operation of the local authorities. A memoir has also been written on the Glossop Sheet (86), which is now ready for press. This geological map is being colour-printed and should be published during 1932. The officers of this division have been also busily engaged in preparing accounts of their district to serve as handbooks to the new Museum and in drafting schemes for exhibits to illustrate the geology of Yorkshire and adjacent counties.

In the Manchester office the work on the Wigan Sheet (84) progresses steadily, but involves an unusually prolonged study of the mining plans which are specially numerous in that coalfield. By the end of the year the first six-inch maps were being proofed for the engraver, and it is expected that the remainder will follow without much delay. The Manchester maps (Sheet 85), solid and drift, have been passed through the press and the descriptive memoir is published. This is a most important contribution to British coalfield geology as the last edition of this map was issued in 1874 and there was no memoir descriptive of it. In this field there is not only much disturbance and faulting, but the correlation of the seams in various parts of the district is often puzzling and obscure. It is believed, however, that the new edition of the map combines all the accessible information and places the interpretation of the Coal Measures geology on a sound basis.

Two members of this unit, Messrs. Tonks and Jones, were sent to Scotland for three months to accelerate the primary survey of the Highlands, and mapped areas of igneous and metamorphic rocks in the neighbourhood of Loch Aline and Loch Sunart, Argyllshire (Sheet 52).

In Cumberland, the field staff, under Mr. T. Eastwood, continued the mapping of the Cockermouth Sheet (23) which they nearly finished before they were withdrawn to London. This Sheet comprises a great variety of rocks both sedimentary and igneous, ranging from Skiddaw Slates to Trias. A considerable area of coalfield ranges across the Sheet, and Mr. Eastwood has practically finished the re-survey of this, so that the six-inch maps can be dry-proofed. In the southern part of the Sheet the older rocks emerge and present many problems, both stratigraphic and petrological, which require careful study. When this Sheet is finished the workable coalfields of Cumberland will all have had revision and the geology, which was by no means well understood before the re-survey began, will be on a new and very satisfactory basis. There are still areas of concealed coalfield and of productive iron ore deposits which require to be examined before the economic geology of Cumberland can be regarded as up-to-date, but the remaining task is now a comparatively light one. Much new information has also been gleaned about the superficial deposits of this region and the north-west of England, and the successive advances and retreats of the ice-sheets, both local, and those which invaded the low plain of Carlisle, and the Vale of Eden, during the Glacial periods. With the completion of the Cockermouth Sheet work will probably be started to the south of Whitehaven where commercial firms are taking an interest in the possible occurrence of deep-seated deposits of haematite.

The geologists working in Northumberland under Mr. R. G. Carruthers, with a local branch office in Newcastle, have been engaged in the re-survey of two districts, one inland, to the south of the Cheviot Hills, and the other near the coast about Blyth and Tynemouth. The former district consists mainly of Lower Carboniferous—the Cementstones and Limestones with the Scremerston Coals which do not seem to be of much value though long worked for local use. This district presents many interesting problems in the transition between the Pennine and Northumberland facies of the Lower Carboniferous, and the gradually increasing development of limestones as the measures are traced southwards and westwards. The coastal district, on the other hand, is made up to a large extent of Millstone Grit and Coal Measures, and represents the northern extremity of the Great Northern Coalfield, rich in valuable seams of coal and intensively engaged in mining and shipbuilding. The structure, as formerly known, is comparatively simple, but the beds are traversed by powerful faults having generally a direction nearly east and west, and the exact correlation and nomenclature of the coal seams are by no means finally settled. Igneous intrusions in these strata are comparatively infrequent and fortunately have done little damage to the coals. Some field work has also been done to complete the information regarding Sheets 9 and 10 (Rothbury and Woodhorn) of the one-inch geological map, which were sent to the engraver during the course of the year.

In Scotland, the field work was divided into two parts according to our normal practice. During the summer months the primary six-inch survey of Highland districts was carried on. In the autumn season it was intended to continue the revision of coalfields in Dumfriesshire, Ayrshire and Fifeshire, but the latter work was much curtailed owing to the change of programmes and the recall of field staff to the office in Edinburgh. Some revision, however, was done in the Sanquhar Coalfield, and Dr. Robertson collected information for a revised issue of certain Stirlingshire Coalfield maps that were out of print and are to be republished on new topographical quarter-sheets. Frequent visits to borings were made by Mr. Manson and by the geologists, and in connection with economic memoirs on Fife and South Ayrshire that are being written, it was necessary in certain cases to visit the field and verify statements before publication.

In the West Highlands, Mr. Richey and his staff had about three months' continuous field work in the district around Loch Sunart and the south end of Loch Shiel (Sheet 52). A special account of that part of the Ardnamurchan volcano that enters into this Sheet has been already issued in the Ardnamurchan memoir, accompanied by a colour-printed map on the scale of two inches to a mile. Of the remainder of this Sheet about one half has been surveyed. It consists mainly of granite and Moine gneisses and is full of interest to petrologists and students of Highland metamorphism, but the details are too complicated to be explained without the use of maps and diagrams. In the southern part of this Sheet there is a large area of Tertiary lava flows adjoining the Sound of Mull and probably an outlying part of the Mull volcano. Two field seasons will be required for the completion of the survey of this Sheet.

In Shetland, a longer field season was possible than in Argyllshire, as there are no deer forests. Mr. G. V. Wilson and his staff of geologists were mostly engaged in the survey of the Mainland or principal island, which has a length of about 54 miles. Mr. Allan continued his survey of Yell which is now completed. Four geologists, with Mr. Wilson, were at work on the Mainland, and when the field season was stopped on the first of October they had finished the survey of an area extending practically along the whole east side of that island. They are working westwards and nearly one half of the archipelago remains to be surveyed. The variety of the rocks contained in the Shetland Islands is extraordinarily great, and the country, though often visited by mineralogists and geologists, has never been adequately surveyed. Consequently, the work that is being carried on there is of a very interesting character. The interior of many of the islands is covered with deep peat, but there is usually bare rock at the higher levels, and the immensely extended coast lines furnish abundant evidence to geologists, though it is frequently impossible to trace inland the formations seen on the coast. The drift deposits are neither deep nor extensive, and the materials of which they are

composed are mostly of local origin. Though the direction of ice movement was approximately from west to east the scarcity of foreign erratics makes it impossible to determine exactly the source from which the ice-sheets came. Only one Scandinavian erratic has as yet been described from Shetland.

Publications

The list of Maps and Memoirs published and in the press during the year will be found on pages 17-23.

A new edition of the geological map of England and Wales on the scale of four miles to one inch has been in hand for several years, and is making considerable progress. For this edition a revised scheme of colours has been prepared, based on methods of colour-printing now used by the Ordnance Survey. An index of colours for this edition was published in 1927, and since then three Sheets of the map have been issued. During the past year two more Sheets have come from the press and four are in course of engraving and colour-proofing. Several others are being prepared in the office and are receiving corrections and additional information, and will soon be sent to the engravers. The order in which they are being taken depends mainly on the exhaustion of the stock of sale copies of the previous edition. This map is very useful for educational purposes, and an effort has been made to present a colour scheme that is sufficiently distinctive to render the geological details visible when the map is used as a wall map for teaching classes.

In Scotland this series of maps cannot be completed owing to the fact that a considerable area of the Highlands has not yet been surveyed, but one quarter-inch Sheet was published and one was in the press, and was practically ready to issue at the close of the year. One of these represents the Clyde valley and Loch Lomond district; the other is the first map to be published showing the results of the survey of the Orkney Islands. Another Scottish quarter-inch map representing the North-west Highlands is being drawn up in the Edinburgh office, but is not yet ready for the engraver.

Of the one-inch New Series of colour-printed maps one English Sheet was published during the year. It was expected that three others would be issued immediately. These belong to the North of England. Two ' solid ' and one ' drift ' Sheet have reference to the Cheviot Hills and the surrounding Carboniferous country, which includes small areas of coal-bearing strata that are worked on a limited scale, while the fourth represents part of Cumberland around Brampton, a district in which several coal seams are worked both in the Limestones and in the Coal Measures.

The memoirs descriptive of these new maps are in the press and will be published early in 1932. There had been no previous memoir on the Brampton country, but C. T. Clough and W. Gunn

wrote descriptive accounts of the Cheviots and the adjacent districts which have been very useful to Mr. Carruthers in preparing the new memoirs of that ground.

In Scotland, two one-inch Sheets have been published showing the geology of North Central Sutherland and part of Caithness. These represent an area of about 900 square miles and complete the maps of the counties mentioned. Both of these Sheets show the ' solid ' rocks by colour and the extensive spread of superficial deposits (including the peat) by means of over-printed stipples. A revised edition also of the special map of the Glasgow district has been published owing to the exhaustion of the stock of the first edition. The previous issue showed ' solid ' by colour and ' drift ' by stipple, but this was not entirely satisfactory owing to the complicated geology of the coalfield and the dense topography of a highly industrialized district. In this edition there are numerous corrections due to additional information recently acquired, and separate ' drift ' and ' solid ' editions have been printed. The result is a great improvement in clearness and vigour, and while the ' solid ' edition will serve best the uses of the mining industry, the ' drift ' edition is most suitable for geographers, agriculturists and civil engineers.

No less than 16 English one-inch Sheets were in the press at the close of 1931, and 11 Scottish one-inch Sheets. Two of the English Sheets, Abergavenny (232) and Atherstone (155) are new issues rendered necessary to maintain the stock of sales copies. Both have received the corrections required to bring them up to date. The other English maps are based on a new survey on the six-inch scale and replace maps of the Old Series which were published hand-coloured, some of them sixty or seventy years ago. Memoirs descriptive of these New Series Sheets are all in course of preparation. The memoir on Saffron Walden is in the press, and the manuscript of the others is being drafted as rapidly as other duties permit.

Of the 11 Scottish one-inch maps in the press, six represent the Orkney Islands and two (Peebles, 24, and Maxwelltown, 9) are based on the revision of the Silurian rocks of Scotland which was executed by Peach and Horne, but not published on the one-inch scale. The Peebles Sheet (24) contains also the results of a re-survey of Old Red Sandstone and Carboniferous rocks that was necessary to make the map satisfactory. It is not intended to issue new memoirs on these Silurian maps as the monograph by Peach and Horne is still the standard work on the subject and contains a wealth of detail on the stratigraphy, palaeontology and petrography. The memoir on the Orkneys is in course of preparation.

Three versions of the map of South Ayrshire (14) are in the press corresponding with those already published of North Ayrshire (22). They are respectively ' solid,' ' drift,' and ' soil ' editions and are intended to show as fully as is possible on this scale the geology of a district of great importance, both industrial and agricultural. The ' soil ' map is based on data which have

been collected specially by Professor McArthur of the West of Scotland Agricultural College. He has made a very large number of mechanical soil analyses, accompanied by determinations of the acidity and the lime-requirement of the soils. This information could not possibly have been shown on an ordinary geological map and the work is of great interest, especially as indicating the connexion that subsists between the geological and agronomic conditions in a typical area of Scottish Lowland country.

The English six-inch coalfield maps published during the year are 29 in number and are representative of six important coalfields, Cumberland, Northumberland, Lancashire, Yorkshire, Shropshire and South Wales. In Scotland, 18 coalfield maps have been published relating to Ayrshire, Fife, Kinross-shire and Lanarkshire. Of the six-inch maps passing through the press 27 are English and 3 are Scottish; these figures indicate that while the revision of the English coalfields is still far from complete, the first revision of the Scottish coalfields is nearly finished. The remaining areas are principally in Fife and in Dumfriesshire (Sanquhar), but a second revision of part of Stirlingshire is now being begun. As the current maps sell out they are being replaced by new issues on a revised topographical basis. The previous survey of this district was made about 20 years ago. A memoir on part of the Stirlingshire Coalfield is now being printed, and a further account of the Kilsyth area, which is specially interesting for its seams of coking coals, is being compiled.

Three colour-printed Vertical Sections illustrative of the sequence in English coalfields were issued during the year, and one of Scotland. Four Scottish Vertical Sections are in the press. Each of these Sheets is intended to illustrate a descriptive coalfield memoir, and has reference to a block of six-inch coalfield maps which are recently published or in the press.

Three important coalfield memoirs were published during the year, viz., Whitehaven, Manchester and West Fife. The first memoir on this list is really the first authoritative account of the coalfield to which it refers, as there was no previous memoir on Whitehaven; and the memoir on Manchester replaces a brief memoir issued in 1864 and long since out of print. The West Fife Coalfield has a long history and is still important: two other memoirs will complete the account of the Fife Coalfield. Professor Read's memoir on Central Sutherland is a description of a very large area of Highland metamorphic rocks, and is full of petrographical details and discussions of the unsolved problems of Pre-Cambrian geology.

At the close of the year five English memoirs and one Scottish memoir were in the press.

Water Supply Memoirs

The memoir on the water supply of Leicestershire, which has been written by Mr. L. Richardson and appeared during the past year, continues the series of memoirs on Midland counties which

he has contributed of recent years and is the twenty-seventh memoir of this group. At present the only additional volume in preparation is a second edition of ' London Wells.' A great number of records has been acquired and many particulars regarding supplies and water levels, as boring is constantly in progress and important wells are being sunk in all parts of London. The gradual fall in the water level in the Chalk, owing to heavy pumping, is at present attracting much interest. It is continuous, and, unless measures are taken to check it, must be progressive. The quality of the water in London deep wells is also showing slow but clearly recognizable changes. It is intended to bring up to date the published information on the underground water supplies of London. On the new six-inch maps which are in preparation the sites of important borings will be marked, and some means may be employed to show the depths to the Chalk and the present water level in the strata.

The following maps, vertical sections and memoirs were published in 1931 :—

I.—Maps

English and Welsh Maps published in 1931

¼ inch to 1 mile :—

Sheet 15.—Birmingham, Northampton, Gloucester, Oxford, Worcester (*Solid Edition. Reprinted, Revised*).

Sheet 16.—Cambridge, Colchester, Ipswich (*Drift Edition. Reprinted, Revised*).

1 inch to 1 mile :—

Sheet 18.—Brampton (*Drift Edition*). Original survey by R. Russell, D. Burns, T. V. Holmes, E. J. Hebert and A. Colvin. Re-surveyed by F. M. Trotter and S. E. Hollingworth; Bernard Smith, District Geologist.

6 inches to 1 mile (coalfield maps) :—

Brecknockshire, 43 S.E.—Seven Sisters. Original Survey by A. Strahan. Revision by T. Robertson.

Brecknockshire, 44 N.W.—Ystradgynlais. Original survey by A. Strahan. Revision by T. Robertson.

Brecknockshire, 44 N.E.—Ystradfellte. Original survey by A. Strahan. Revision by T. Robertson.

Brecknockshire, 44 S.W.—Tir-bach. Original survey by A. Strahan. Revision by T. Robertson.

Cumberland, 35 S.E.—Oughterside and Allerby. Surveyed by R. Russell. Re-surveyed by T. Eastwood; B. Smith, District Geologist.

Cumberland, 36 N.W.—Aspatria. Surveyed by T. V. Holmes. Re-surveyed by T. Eastwood; B. Smith, District Geologist.

Glamorganshire, 9 N.E.—Dulais Valley (part of). Original survey by A. Strahan. Revision by T. Robertson.

Glamorganshire, 10 N.W.—Glyn-Neath. Original survey by A. Strahan. Revision by T. Robertson.

Lancashire, 97 N.E.—Austerlands. Original survey by E. Hull. Re-surveyed by W. Lloyd and Wilfrid Edwards; W. B. Wright and C. N. Bromehead, District Geologists.

Northumberland, N.44 N.W.—Amble. Original survey by W. Topley. Revised by R. G. Carruthers and A. Fowler; R. G. Carruthers, District Geologist.

Northumberland, N.44 S.W.—Hauxley. Original survey by W. Topley. Revised by A. Fowler; R. G. Carruthers, District Geologist.

Northumberland, N.51 N.W.—Felton. Original survey by W. Topley. Revised by A. Fowler; R. G. Carruthers, District Geologist.

Northumberland, N.51 S.W.—Eshott. Original survey by W. Topley. Revised by A. Fowler and J. Maden; R. G. Carruthers, District Geologist.

Northumberland, N.51 S.E.—Widdrington. Original survey by W. Topley. Revised by A. Fowler; R. G. Carruthers, District Geologist.

Northumberland, N.52 N.W.—Chevington Drift. Original survey by W. Topley. Revised by A. Fowler; R. G. Carruthers, District Geologist.

Northumberland, N.60 N.W.—Earsdon. Original survey by W. Topley. Revised by A. Fowler and J. Maden; R. G. Carruthers, District Geologist.

Northumberland, N.60 N.E.—Ulgham. Original survey by W. Topley. Revised by A. Fowler and J. Maden; R. G. Carruthers, District Geologist.

Northumberland, N.60 S.E.—Longhirst. Original survey by W. Topley. Revised by A. Fowler; R. G. Carruthers, District Geologist.

Northumberland, N.61 S.W.—Woodhorn. Original survey by W. Topley. Revised by A. Fowler; R. G. Carruthers, District Geologist.

Northumberland, N.61 S.E.—Newbiggin Colliery. Original survey by W. Topley. Revised by A. Fowler; R. G. Carruthers, District Geologist.

Northumberland, N.69 N.W.—Morpeth. Original survey by W. Topley. Revised by A. Fowler; R. G. Carruthers, District Geologist.

Northumberland, N.70 N.E.—Newbiggin by the Sea. Original survey by W. Topley. Revised by A. Fowler; R. G. Carruthers, District Geologist.

Shropshire, 36 S.W.—Wellington and Hadley. Surveyed by T. H. Whitehead; T. C. Cantrill, District Geologist.

Shropshire, 43 N.W.—Little Wenlock. Surveyed by R. W. Pocock; T. C. Cantrill, District Geologist.

Shropshire, 43 S.W.—Coalbrookdale and Ironbridge. Surveyed by R. W. Pocock; T. C. Cantrill, District Geologist.

Shropshire, 51 N.W.—Broseley and Barrow. Surveyed by T. Robertson; T. C. Cantrill, District Geologist.

Shropshire, 51 N.E.—Sutton Maddock. Surveyed by T. Robertson; T. C. Cantrill, District Geologist.

Yorkshire, 216 N.E.—Bradford. Original survey by J. C. Ward, J. Lucas, C. Fox-Strangways and R. Russell. Re-surveyed by J. V. Stephens; C. N. Bromehead, District Geologist.

Yorkshire, 260 S.E.—Honley and Thurstonland. Original survey by J. R. Dakyns and J. C. Ward. Re-surveyed by D. A. Wray; C. N. Bromehead, District Geologist.

Scottish Maps published in 1931

¼ inch to 1 mile :—

Sheet 14.—Stirlingshire, Dumbartonshire, Renfrewshire, with parts of Lanarkshire (North and Central), Ayrshire (North), Buteshire (North), and Argyllshire (South-East).

1 inch to 1 mile :—

Sheet 108.—*Altnaharra. Original survey by B. N. Peach, J. Horne, C. T. Clough, H. M. Cadell, C. B. Crampton, M. Macgregor, C. H.*

Dinham, J. E. Richey, G. V. Wilson, H. H. Read, D. Haldane, G. Ross, J. Phemister, L. H. Tonks and W. Anderson.

Sheet 109.—Achentoul. Original survey by B. N. Peach, J. Horne, H. Miller, E. Greenly, T. I. Pocock, C. B. Crampton, R. G. Carruthers, and M. Macgregor. Revision by H. H. Read.

Glasgow District Map (*Solid and Drift Editions*). Original survey by E. Hull, J. Geikie, B. N. Peach and R. L. Jack. Revised by B. N. Peach, C. T. Clough, L. W. Hinxman, J. S. Grant Wilson, C. B. Crampton, W. B. Wright, E. B. Bailey, E. M. Anderson, R. G. Carruthers and G. W. Grabham. Solid with Drift published in 1911. Additional information added 1929.

6 inches to 1 mile (coalfield maps):—

Ayrshire, 30 S.E.—Wellwood House S.W. of Muirkirk. Original survey by B. N. Peach. Revised by E. M. Anderson and G. V. Wilson; M. Macgregor and J. E. Richey, District Geologists.

Ayrshire, 36 N.W.—Cronberry. Original survey by B. N. Peach. Revised by E. M. Anderson and J. B. Simpson; E. B. Bailey, District Geologist.

Ayrshire, 41 N.E.—Carsgailoch Hill, W. of New Cumnock. Original survey by J. Geikie. Revised by J. B. Simpson; E. B. Bailey, District Geologist.

Ayrshire, 42 N.W.—Pathhead. Original survey by B. N. Peach. Revised by V. A. Eyles and J. B. Simpson; E. B. Bailey, District Geologist.

Ayrshire, 42 S.W.—New Cumnock. Original survey by B. N. Peach. Ordovician revised by B. N. Peach and J. Horne. Post-Ordovician revised by E. M. Anderson and J. B. Simpson; E. B. Bailey, District Geologist.

Fifeshire, 28 S.W.—Thornton. Original survey by H. H. Howell. Revised by J. Knox; C. H. Dinham, District Geologist.

Fifeshire, 33 N.E.—Lethans. Original survey by A. Geikie. Revised by D. Haldane and C. H. Dinham; C. H. Dinham, District Geologist.

Fifeshire, 33 S.W.—Saline, Kinneddar. Original survey by A. Geikie. Revised by D. Haldane; C. H. Dinham, District Geologist.

Fifeshire, 33 S.E.—Craigluscar. Original survey by A. Geikie. Revised by D. Haldane and C. H. Dinham; C. H. Dinham, District Geologist.

Fifeshire, 34 S.W.—Kingseat. Original survey by A. Geikie. Revised by J. K. Allan, C. H. Dinham and D. Haldane; C. H. Dinham, District Geologist.

Fifeshire, 36 N.W.—Dysart. Original survey by H. H. Howell. Revised by J. Knox; C. H. Dinham, District Geologist.

Fifeshire, 38 N.W.—Newmills, Oakley. Original survey by A. Geikie. Revised by D. Haldane; C. H. Dinham, District Geologist.

Fifeshire, 38 N.E.—Dunfermline (W. part). Original survey by A. Geikie. Revised by D. Haldane; C. H. Dinham, District Geologist.

Fifeshire, 38 S.E.—Charlestown. Original survey by A. Geikie. Partly revised by H. B. Maufe. Revised by D. Haldane; C. H. Dinham, District Geologist.

Fifeshire and Kinross-shire, 25 S.W.—Powmill. Original survey by A. Geikie and J. Geikie. Revised by D. Haldane; C. H. Dinham, District Geologist.

Fifeshire and Kinross-shire, 25 S.E.—Cleish Castle. Original survey by A. Geikie. Revised by D. Haldane; C. H. Dinham, District Geologist.

Fifeshire and Kinross-shire, 26 S.E.—Ballingry. Original survey by A. Geikie and H. H. Howell. Revised by J. K. Allan; C. H. Dinham, District Geologist.

Lanarkshire, 18 S.E.—Dalserf. Original survey by J. Geikie. Revised by L. W. Hinxman, M. Macgregor and C. H. Dinham; M. Macgregor, District Geologist.

Manuscript copies of the following maps on the scale of six inches to one mile were deposited in the Library for public reference. They are not to be published. The English maps are deposited in the head office in London. These manuscript copies of unpublished maps may be examined in the Library of the Geological Survey on week-days from 10 a.m. to 5 p.m. Copies of them may be obtained at the cost of drawing which will be quoted on application to the Superintendent of Maps. Photographs of these maps will also be supplied, on the scale of 3 inches to one mile approximately, at the cost of 2*s*. 6*d*. to 3*s*. 6*d*. per quarter-sheet.

The Scottish manuscript copies which are deposited in the office at 19, Grange Terrace, Edinburgh may on application be forwarded to the London office for consultation.

Library Copies of English Manuscript Standard Maps deposited for reference

Cheshire, 43 S.E.
Surrey, 18 S.E.; 19 S.W., S.E.; 20 S.W., S.E.; 25 N.E., S.W., S.E.; 26 N.W., N.E., S.W., S.E.; 27 N.W., N.E., S.W., S.E.; 33 N.W., N.E., S.W., S.E.; 34 N.W., N.E., S.W., S.E. ; 35 N.W., N.E., S.W., S.E.; 40 N.W. (part), N.E. (part); 41 N.W. (part), N.E.; 42 N.W., N.E.; 46 N.W., N.E.
Yorkshire, 259 S.E.; 272 N.W.

Scottish Manuscript Maps deposited for reference

Argyllshire (Mull), 84.
Ayrshire, 25 N.W.
Buteshire, 225 N.E., S.E.; 226 N.W., S.W., S.E.; 227 N.W., N.E.; 237; 238; 243; 244; (245 S.W. and 250 N.W., S.W.); 248 N.E., S.E.; 249.
Lanarkshire, 10 S.W., S.E.; 16 N.W.
Renfrewshire, 17 S.E.

List of Maps in the press at the close of 1931

English Maps in the press

½ inch to 1 mile :—

Sheet 7.—Leeds, Manchester, York, etc. (*Solid Edition, Reprint*).
Sheet 14.—Aberystwyth, Carmarthen, Hereford (*Solid Edition, Reprint*).
Sheet 19.—Bath, Guildford, Abingdon, Southampton (*Solid Edition, Reprint*).
Sheet 20 with 24.—London, Dover and Brighton (*Solid and Drift Editions, Reprint*).

1 inch to 1 mile :—

Sheet 3.—Ford (*Solid and Drift Editions*).
Sheet 5.—Cheviot (*Drift Edition*).
Sheet 9.—Rothbury (*Solid and Drift Editions*).
Sheet 10.—Woodhorn (*Solid and Drift Editions*).

Sheet 86.—Glossop (*Solid and Drift Editions*).
Sheet 152.—Shrewsbury (*Solid and Drift Editions*).
Sheet 155.—Atherstone (*Drift Edition, Reprint*).
Sheet 205.—Saffron Walden (*Drift Edition*).
Sheet 232.—Abergavenny (*Revised Drift Edition*).
Sheet 235.—Cirencester (*Drift Edition*).
Sheet 286.—Reigate (*Drift Edition*).

6 inches to 1 mile (coalfield maps):—

Brecknockshire, 43 N.E.; 44 S.E.; 46 S.W.; 49 N.E.; 50 N.W., N.E.; 51 N.W.
Cumberland, 45 N.E.
Glamorganshire 9 S.E.; 10 S.W., S.E.; 11 S.W., S.E.; 12 S.W.
Lancashire, 89 S.E.; 97 S.E.; 105 N.E.
Northumberland, N.51 N.E.; N.60 S.E.; N.61 N.W.; N.69 N.E.; N.70 N.W.
Staffordshire, 67 N.W., S.W.
Yorkshire, 218 S.W.; 247 S.E.; 261 N.E.

Scottish Maps in the press

¼ inch to 1 mile:—

Sheet 3.—Orkney Islands.

1 inch to 1 mile:—

Sheet 9.—Maxwelltown (*Solid with Drift*).
Sheet 14.—Ayr (*Solid, Drift and Soil Texture Editions*).
Sheet 24.—Peebles (*Solid with Drift*).
Sheet 117.—Hoy
Sheet 118.—Copinsay
Sheet 119.—Kirkwall
Sheet 120.—Stronsay
Sheet 121.—Westray
Sheet 122.—Sanday
} Orkney Islands (*Drift Editions*).

6 inches to 1 mile (coalfield maps):—

Ayrshire, 36 S.W.
Lanarkshire, 37 S.E.; 38 S.W.

II.—Vertical Sections of Strata

English Vertical Sections published in 1931

Sheet 93.—Sections of Shafts in the Coal Measures of the Abergavenny District (Sheet No. 232) of the South Wales Coalfield, being supplementary to Vertical Sections, Sheet 81.
Sheet 94.—Sections of Shafts and Borings in the Southern Part of the South Staffordshire Coalfield.
Sheet 95.—Sections of Shafts and Borings in the Southern Part of the West Cumberland Coalfield.

Scottish Vertical Sections published in 1931

Sheet 16.—Illustrative of the Ayrshire Coalfields. Area III (Prestwick, Mauchline, Cumnock and Muirkirk). Arranged by V. A. Eyles and J. B. Simpson.

Scottish Vertical Sections in the press at the close of 1931

Sheet 17.—Illustrative of the North-east Stirlingshire Coalfield.
Sheet 18.—Illustrative of the Clackmannanshire Coalfield, including part of West Fife.
Sheet 19.—Illustrative of the Fife Coalfields. Area I (Dunfermline and West Fife).
Sheet 20.—Illustrative of the Ayrshire Coalfields. Area IV (Dailly, Patna, Dalmellington and New Cumnock).

III.—Memoirs

English Memoirs published in 1931

Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the year 1930:—
Part I.—With Report of the Geological Survey Board and Report of the Director. 92 pp., 2 plates, 2 text-figures. 1931. Price 2*s. net.*
Part II.—90 pp., 4 plates, 19 text-figures. 1931. Price 2*s. net.*
Part III.—92 pp., 5 plates, 18 text-figures. 1931. Price 2*s. net.*

Chemical Analyses of Igneous Rocks, Metamorphic Rocks, and Minerals. *Compiled from the Records of the Geological Survey.* By Eileen M. Guppy, B.Sc., F.G.S., with Petrographical Descriptions by H. H. Thomas, Sc.D., F.R.S., and notes on the Methods of Analysis employed by F. R. Ennos, B.A., B.Sc., A.I.C., and R. Sutcliffe, M.A., A.I.C. 166 pp. 1931. Price 3*s.* 6*d. net.*

Wells and Springs of Leicestershire. By L. Richardson, F.R.S.E., F.G.S. 160 pp., 1 plate, 4 text-figures. 1931. Price 3*s. net.*

The Geology of the Whitehaven and Workington District. (Explanation of one-inch Sheet 28: England and Wales). By T. Eastwood, A.R.C.Sc., E. E. L. Dixon, A.R.C.Sc., B.Sc., S. E. Hollingworth, M.A., D.Sc., and Bernard Smith, M.A., Sc.D., District Geologist. 304 pp., 8 plates, 27 text-figures. 1931. Price 6*s. net.*

The Geology of Manchester and the South-East Lancashire Coalfield. (Explanation of one-inch Sheet 85: England and Wales). By L. H. Tonks, M.Sc., R. C. B. Jones, M.C., M.Sc., W. Lloyd, B.Sc., and R. L. Sherlock, D.Sc., A.R.C.Sc., with a Chapter on the Palaeontology by W. B. Wright, Sc.D. 240 pp., 7 plates, 68 text-figures. 1931. Price 5*s. net.*

Scottish Memoirs published in 1931

The Economic Geology of the Fife Coalfields. Area I (Dunfermline and West Fife, including Valleyfield, Blairhall, Oakley, Saline, Halbeath, Lassodie and Blairenbathie). By D. Haldene, B.Sc., and J. K. Allan, M.A., B.Sc., with contributions from C. H. Dinham, B.A. 158 pp., 2 plates, 9 text-figures. 1931. Price 3*s.* 6*d. net.*

The Geology of Central Sutherland (East-central Sutherland and South-western Caithness). (Explanation of one-inch Sheets 108 and 109: Scotland). By H. H. Read, D.Sc., A.R.C.Sc., F.R.S.E. 238 pp., 5 plates, 13 text-figures. 1931. Price 4*s.* 6*d. net.*

English Memoirs in the press at the close of 1931

Guide to the Geological Model of the Isle of Purbeck. *Second Edition.*
The Geology of the Cheviot Hills. (Explanation of one-inch Sheets 3 and 5: England and Wales).
The Geology of the Brampton District. (Explanation of one-inch Sheet 18: England and Wales).
The Geology of the Country near Saffron Walden. (Explanation of one-inch Sheet 205: England and Wales).

The Geology of the Country around Torquay. (Explanation of one-inch Sheet 350). *Second Edition.*

Scottish Memoirs in the press at the close of 1931

The Economic Geology of the Stirling and Clackmannan Coalfield.

Geophysical Work

In the 'Summary of Progress' for last year three reports on geophysical investigations made their appearance, two of these being on magnetic methods and one on gravitational geophysical surveying. As the time approaches when it will be necessary to transfer the offices, library and collections to the new Museum the energies of Dr. McLintock and Mr. Hallimond will be absorbed in their proper duties of library and museum work. Hence it was evidently becoming more and more difficult for them to spare time for geophysical investigations, especially as these entailed prolonged absences in the field. At the same time it was felt exceedingly difficult to fill their place by diverting field officers to this kind of work. It requires prolonged training and special qualifications, and if the work is to be reliable it involves great patience and much expenditure of time. Hence, with the consent of the Geological Survey Board, it was decided to close down the geophysical field work for a time in order to meet the urgent necessity of preparation for the new Museum. With the publication of the reports above mentioned practically all the work of this kind that has been done by the staff of the Geological Survey has been published, and the results are open to all who study this subject.

As the Survey had a considerable equipment of geophysical instruments, gravitational, magnetic and seismic, and as it seemed unnecessary to exhibit these in the Museum, since there is a special display of geophysical apparatus in the Science Museum, South Kensington, the Director, with the approval of the Secretary of the Department, handed over the collection of geophysical apparatus to Professor Rankine, who is conducting a course of instruction in geophysical surveying at the Imperial College of Science. These instruments which are on loan to the new School of Geophysics will thus serve a useful purpose, and as they have all been thoroughly tried out in the field their uses and their limitations are well understood.

In the course of our work in magnetic geophysical surveying very valuable assistance was obtained from the National Physical Laboratory, which carried out tests of the magnetic properties of certain rocks which are typical of the districts in which the field surveys had been executed. These results throw much light on the magnetic fields as ascertained by magnetometric methods, and, in fact, without these tests it would have been impossible to reconcile the results of the magnetic and gravitational surveys. Some

further studies of this sort are being made by physicists who are interested in the magnetic properties of rocks, but as yet the results are not ripe for publication. For these researches the Geological Survey is supplying the materials tested.

Soil Surveys

As was stated in this ' Report ' for last year a Soils Correlation Committee was set up under the auspices of the Ministry of Agriculture and Fisheries and the Department of Agriculture, Scotland, to discuss methods of soil surveying and mapping and more especially the classification of British Soils. This Committee consisted mainly of agricultural soil experts, and it was decided that visits should be made to the principal districts in England where soil investigators were at work in order to see what characters were most important in describing and classifying soils. It was considered important that the members of this Committee should be accompanied by a geologist who was familiar with the use of geological maps and the lithological properties of British rocks. Mr. Dines was selected for this purpose, and has contributed the following report on the work of the Committee.

" The Soils Correlation Committee, set up in 1930, completed two tours in April and May 1931, during which the more important areas in which soil surveying is in progress in England and Wales were visited. The Committee consists of Prof. G. W. Robinson (Chairman), Mr. H. G. Dines, Prof. J. A. Hanley, Dr. W. G. Ogg, Dr. T. Wallace, and Mr. W. Morley Davies (Secretary for Field Work).

The districts visited during the tours were as follows :—

April tour.—Newton Abbot (Devon), Long Ashton (Bristol), Pershore (Worcestershire), Cardiff, Newport (Salop), Bangor, Denbighshire, Flintshire, Cheshire, Manchester, Leeds, and Vale of York.

May tour.—Maidstone, Reading, Oxford, Rothamsted, Cambridge, Leicester, and Nottingham.

In most of the above districts detailed soil surveying is in various stages of progress, and the soil surveyors had prepared profile sections of the more general and widespread of their local soil types, for examination by the Committee.

A soil is described in terms of its profile, or vertical section, including all the horizons which have been differentiated from the parent material by soil-forming processes. In any climatic region the characters of the soil profile are determined by the parent material, the mode of the soil's formation, the topography, and the natural drainage conditions. When all these are alike they give rise to soils having similar profile characters, the same horizons occur, the colour and structure of soil particles are alike and the soil can be referred to a definite series, which is the unit of soil

classification that has been adopted in this country. Gradations in texture enable the surveyor further to sub-divide soils into types; but for the present surveyors are concentrating on defining soil series.

The main object of the Committee was to suggest a scheme for broad classification by which a number of soil series might be grouped together, and which would be applicable to the country as a whole. Grouping by climatic regions, such as is being done on the Continent, has not been satisfactorily applied in this country, where the soils are of comparatively recent date. In most cases the soils, though not necessarily ' immature ' in the strict sense, have been modified by centuries of cultivation, so that the climatic conditions prevailing in this country are not fully expressed in the soil profile. Moreover, there are, in England, soils which, according to the Continental grouping, would be classed respectively as brown-earths and podsols, occurring under identical climatic conditions. It is obvious, therefore, that climate is not the determining factor in the soils of England and Wales. The examination of many soil profiles in widely separated districts has led to the conclusion that in this country parent material is the most prominent and influential of the variables by which a soil is distinguished. Parent material, therefore, affords the most satisfactory basis for the primary classification and grouping of soil series.

By this method all geological deposits having similar lithological and petrographic characters are grouped together as one class of parent material. Certain geological formations of widely different ages produce similar soils, as, for example, the Old Red Sandstone of South Wales and the arenaceous divisions of the Trias of the Midlands; also shales of various ages, such as the Cambrian, Ordovician and Silurian of Wales, and the Devonian of Devon. On the other hand, the composition and texture of irregular deposits like the Boulder Clay may vary considerably, and it may, therefore, be necessary to subdivide Boulder Clay areas so as to separate the different parent materials present.

The parent material classes so far adopted for this scheme of classification are as follows :—

1. Schists.
2. Grey and black shales.
3. Grey clay and clay shales, calcareous.
4. Grey clay and clay shales, non-calcareous.
5. Hard grey sandstone.
6. Red sands.
7. Pebbly red sands.
8. Coarse yellow sand.
9. Yellow sand, calcareous.
10. Highly ferruginous sands.
11. Glauconite sands.
12. Massive limestones.
13. Soft white limestone.
14. Yellow limestone.
15. Igneous rocks.
16. Red marls.
17. Brickearths.
18. Clay-with-flints.
19. Peat, moor and fen.

The list includes only the parent materials already recognized by the Committee. It may require modification, and will, of necessity, require amplification.

As a result of classification by this method it has thus been possible to group the soils examined into 19 broad classes, most of which must hold good over extensive areas. In all some 170 soil series were described, of which 60 were of local occurrence only. It is clear that a number of the series named in the provisional list drawn up, will on further examination prove to be identical. The Committee is now engaged in revising the series described by them."

In Scotland, Prof. McArthur has continued his studies of the soils of South Ayrshire. With the assistance of his students he has determined the phosphate content of 3,000 samples of soils by a rapid colorimetric method. He has also measured the ' lime requirement ' and the pH value of a large number of specimens, and has completed his mechanical analyses of the soils over the whole area represented on the South Ayrshire map, a district extending to nearly 500 square miles. The results have now been plotted on a series of maps which will serve to illustrate the chapter on Soils which he is writing for the memoir descriptive of that Sheet. This is a very important contribution to our knowledge of the physical and chemical properties of Scottish soils, and as the district covered is one of varied topography and agricultural activities it is well adapted for an investigation of this order. The special one-inch map showing the physical characters of the soils is being engraved and will be published along with the usual 'solid' and ' drift ' editions of that Sheet.

Inspections of Bores and Shafts

The powers conferred by the Mining Industry Act of 1926 on the Geological Survey to examine all borings and sinkings in search of minerals to a depth of 100 feet and over have again proved of the highest possible value to the Geological Survey. No difficulty has been experienced in the working of the Act, and every facility has been given by the mining companies, engineers and shaft sinkers. In fact, it is not uncommon to receive requests to visit a boring which is in progress and discuss with the engineers the possible interpretations of the results in cases where the geological evidence is obscure or differs in any way from what had been anticipated. Two officers have been detailed specially for this work, Mr. A. Templeman in England, and Mr. W. Manson in Scotland, and they are constantly employed in obtaining bore and shaft records, verifying the journals, and collecting specimens of rocks, fossils and minerals for future reference. Most of the bore records are compiled not only in manuscript, but also in graphic form, as this much increases their value when a large number of borings has to be compared and correlations of the economic strata are to be inferred. In Scotland, a special fire-proof store room has been provided for the custody of the collection of bore records.

In England and Wales during 1931 seven new notifications were received under the Mining Industry Act (1926). These notifications

covered twenty-three boreholes, shafts and drifts. One notification was received under the Petroleum (Production) Act, 1918.

During the year Mr. Templeman has visited three shafts and forty-six borings in various counties from Cumberland to Kent; of these, two were for coal, twenty-three for iron ores, one for lead ore and spar, twenty for limestone, two for water, and one for oil. With the exception of four all were completed before the end of the year.

A fine series of specimens from the Carboniferous Limestone has been obtained from the new shaft sinking at Hodbarrow Mines, Millom, Cumberland. Study of these shows that the zonal horizons traversed are much lower in the Carboniferous Limestone Series than had been suspected.

Inspections of bores—notified or otherwise—have been made at regular intervals by other members of the staff in their respective districts. These amount in number to about forty individual visits, covering some twenty-five borings, chiefly made in Lancashire, Cheshire and Yorkshire.

We are indebted to the officials of the various companies and undertakings concerned for facilities to examine cores, etc., and for information given; and also to Professor W. S. Boulton, of Birmingham University, for instruction about borings in that city, and for the gift of large cores of the local breccia and conglomerate for exhibition in the new Museum.

In addition to this work, the checking, filing and collection of old records has been continued. Journals and sections amounting to over two thousand in number have been copied from the books of Messrs. Mather & Platt, Ltd., Manchester; John Thom, Patricroft; Guthrie, Allsebrook & Co., Reading; Le Grand, Sutcliff & Gell, Ltd., Southall, Middlesex, and the London County Council.

Other important records have been received as donations from the Executors of the late Arnold Lupton, J. D. Kendall, and T. C. Cantrill respectively. To all of these we acknowledge our thanks.

Thirty-one notifications of borings, mines, or shafts were received in the Scottish Office during 1931. Nine of these notifications included two or more borings or mines, and in some instances a shaft and a bore. The inspection of these has been carried out mainly by Mr. Manson, though visits have also been made by geologists concerned in mapping the ground where borings, or sinkings, have been in progress. The exact sites of new bores, shafts, and mines have been inserted on the six-inch working maps. Copies of the journals have been obtained and checked.

A boring put down near Valleyfield in West Fife has supplied an interesting section of the Index Limestone and of the marine sediments associated with it. In the neighbourhood of Valleyfield these strata are not exposed at the surface and the succession has not previously been known in detail. The Index Limestone is not so well developed in Fife as in the Central Coalfield, and in the Valleyfield bore the horizon was found to be composed of two thin beds of impure limestone.

Three other marine horizons were found in the bore at seven, twelve and fifteen fathoms respectively above the Index Limestone. Of the lamellibranchs from these horizons near the Index Limestone several are also common in the assemblage found in the Johnstone Shell-bed, near the base of the Limestone Coal Group.

Building Stones Research

During 1931 the Portlandian rocks of the Isle of Portland and elsewhere were further examined in connexion with Building Stones Research, and specimens collected; these specimens are to be tested at the Building Research Station.

In order to confirm some of the conclusions reached as a result of the physical tests applied it was considered desirable to carry out close collecting from the beds of building stone at one locality. This collecting was undertaken by Mr. F. H. Edmunds, in conjuction with Mr. B. Bakewell, of the Building Research Station, in August, 1931. For this purpose, the Suckthumb group of quarries at Portland was chosen, and a plan of the quarries on the scale of 100 in. to one mile prepared. The beds of stone suitable for building stone are here about 18½ ft. thick, and are divided into Whit bed, Top tier, Whit bed, Bottom tier (sometimes called " Seedy tier "), Hard tier, and Base bed.

A series of rock specimens was collected from the quarry face, the location of each sample being indicated on the plan. Thus an accurately located suite of specimens, thoroughly representative of the building stone beds of the Suckthumb quarry, was obtained.

The specimens so collected were sent to the Building Research Station, where they are undergoing physical tests similar to those applied to the earlier series of rock samples.

Conferences

At the Centenary Meeting of the British Association in September, Mr. Henry Dewey gave an address on the Geology of the London District, illustrated by maps and lantern slides. Several members of the Geological Survey also assisted in leading excursions to places of geological interest in the neighbourhood of London.

An exhibit of geological maps and memoirs relating to London and district, published by the Geological Survey, was held in a room adjacent to the meeting room of the Geological Section. Photographs, rocks and fossils recently collected, in preparation for the new Museum, were also shown.

At the 50th Anniversary of the Natural History Museum, South Kensington, and the celebration of the Faraday Centenary in London, the Geological Survey was represented by the Director.

In August the Geologists' Association held a field excursion to Northumberland, and several members of the Geological Survey staff took part in the conduct of excursions to the areas in which revision work had recently been in progress.

Staff Changes

In July, Mr. John Allen Howe, O.B.E., retired from the post of Assistant to the Director, which he had occupied since 1920, and Dr. Bernard Smith was appointed to succeed him. By long service and intimate knowledge of economic geology Mr. Howe had played a most important part in Survey business, and his unfailing courtesy and diligence specially qualified him for the duties of his post. Appointed in 1901, he became Curator of the Museum of Practical Geology in 1902, and devoted much time and care to building up the economic collections, the library and the photographic department. He carries with him in his retirement the sincere good wishes of all his colleagues.

The only appointments to the geological staff during the year were those of Mr. S. Buchan and of Dr. F. B. A. Welch, who was acting as Assistant in the Geological Department of St. Andrew's University. Dr. F. M. Trotter, Mr. A. Fowler, and Mr. J. B. Simpson were promoted to the rank of Senior Geologist as from 1st January, 1932.

In March Dr. H. H. Read, Senior Geologist, resigned from the Geological Survey Staff on being appointed Professor of Geology in the University of Liverpool. Professor Read, during his period of service, has been a notable contributor to many Highland memoirs including Banff, Huntley and Turriff (86 and 96), Golspie (103) Strath Oykell (102) and Central Sutherland (108 and 109). He has completed the mapping of Unst, Shetland, and intends to contribute an account of the geology of that island to the forthcoming memoir on the Shetlands.

Collaboration

As in former years the Geological Survey has received much friendly assistance from specialists in various departments. The following may specially be mentioned: Prof. D. M. S. Watson (fossil fishes), Prof. Lang (fossil plants), Prof. A. E. Trueman (fossil freshwater lamellibranchs), Prof. H. L. Hawkins (echinoderms), Dr. Gertrude Elles (graptolites), Dr. E. S. Cobbold (Cambrian fossils), Mr. W. S. Bisat (Carboniferous goniatites), Dr. Stanley Smith (Palaeozoic corals).

Mr. W. D. Ware has continued to make very useful collections of fossil animals and plants from the Carboniferous of South Wales.

Presentation of Maps, Records, etc., to the Survey

(1) A number of maps, books, sections and boring and shaft journals from the collection of the late Arnold Lupton was presented by Mrs. Arnold Lupton of 7, Victoria Street, S.W. Some of these have been transferred to the files in the York Office.

(2) Advantage was taken of the permission given to the Survey by Mrs. Cantrill of Kidderminster to select any maps or records

from the effects of the late T. C. Cantrill. Some of these will be of great value in helping in the study of the Wyre Forest Coalfield (now under survey) and other parts of the Midlands.

(3) Mrs. J. D. Kendall, of Harold Road, Upper Norwood, handed over a comprehensive collection of sections, records, specimens and plans, gathered by her late husband during many years experience as a consulting mining engineer in Cumberland and Furness.

Our thanks are due to these donors.

Accommodation

The additional Collection Rooms which were being built in Edinburgh as an annexe to the Survey Offices were finished in April and all the collections of fossils and rocks were immediately transferred to them. Dr. John Pringle and Mr. David Tait superintended the removal of the material from the rooms and cellars in which it had been previously stored. The existing cabinets proved satisfactory for erection in the new rooms, where they occupy nearly the whole of the wall-space, leaving a certain amount of floor area for the erection of cabinets as they are required by the future growth of the collections. The whole series has been placed in order in a preliminary manner and is now ready for rearrangement, cataloguing and registration in a way which was previously quite impossible owing to the lack of working space. Special cabinets have been assigned to the recently acquired John Smith collection and also to the series of Scottish fossil algae presented by Professor Garwood.

With the removal of the collections from the rooms in the office it becomes possible to rearrange the library and to provide a suitable room for members of the public who wish to consult the manuscript maps of the Geological Survey and the albums of British photographs. It is expected that this will be begun early in 1932.

In London no addition had been made to the storage and no alterations in the Museum of Practical Geology. Steps were being taken to clear out some of the exhibits in order to obtain more working space. The new Museum at South Kensington is about half completed so far as the external walls and roof are concerned. No part of it is likely to be ready for occupation for another twelve months.

Palaeontology

England and Wales.—The fossils added to the collections during the year numbered 8,440 specimens, of which 2,947 were obtained by presentation or by purchase. Of these special collections, not acquired in the course of the current Survey work, the most notable were a set of 1,877 well localized Jurassic fossils, chiefly from the Great Oolite Series, obtained from Mr. L. Richardson, and a number of choice Jurassic type-brachiopods from the collection of Mr. J. W. Tutcher. Mr. E. F. Herroun sent

a series of fine specimens, mainly from the Silurian of Dudley and Malvern, which he presented in memory of his father, the late H. L. Herroun. Mr. A. G. Davis presented a useful set of mounted and named Microzoa from the Atherfield Clay, the Gault and the Upper Chalk of Surrey. A number of miscellaneous fossils were received from Miss M. S. Johnston, who permitted Mr. C. P. Chatwin to select them from her cabinets, in order to supplement the general collection of fossils of stratigraphical importance.

Much time has been spent by all members of the staff of the Palaeontological Department in the preparation of exhibits to illustrate the geology of different districts in England and Wales, according to the projected scheme of regional display in some of the galleries of the new Museum. It has been necessary to carry out much revision and rearrangement of the various stored collections which do not form part of the present exhibition, in order to facilitate the selection of specimens required for the completion of particular cases in the new Museum.

In addition to carrying out editorial and supervision work, Dr. Kitchin devoted much time to matters of detail connected with the planning of exhibits for the new Museum. The examination and naming of fossils collected in the course of the current Survey work, and the preparation of lists and reports for the purpose of memoirs, proceeded as usual, to some extent by the collaboration of specialists who are not members of the staff. Mr. Chatwin determined fossils from the Inferior Oolite and Lower Chalk in the area of Sheet 327 (Bridport), and from the Chalk and Lower Greensand in the area of Sheet 287 (Sevenoaks); also a series of fossils from the Cornbrash and Kellaways Beds collected from a new cutting on the Great Western Railway near Frome, and various sets of specimens presented to the Museum. He prepared two plates illustrative of typical Devonian fossils, for inclusion in the forthcoming memoir on Sheet 350 (Torquay). He also completed the work of collating the Jurassic fossils in the Geological Society's Collection, previous to the registration of the specimens. He assisted in the preparation of an exhibit illustrating the geology of South-east England, shown at South Kensington on the occasion of the Centenary Meeting of the British Association.

Dr. C. J. Stubblefield continued to name fossils collected in the course of geological surveying in Cumberland (Sheet 23) and in connexion with revision-work proceeding in South Wales (Sheet 231); he also named specimens from a series of borings in Yorkshire (Sheet 77). He drew up many lists of the fossils obtained from the districts in these and in other Sheets that are in course of being surveyed. A visit paid by him, in company with Mr. Eastwood and Dr. Trotter, to various localities in the neighbourhood of Cockermouth greatly facilitated his palaeontological studies in connexion with work on Sheet 23. Dr. Stubblefield also devoted much attention to the selection of material for stratigraphical and zonal exhibits to be arranged in the new Museum, apart from the illustrations of regional geology.

Miss M. E. Odell has been chiefly engaged in registration-work, and has made further progress in dealing with the specimens in the Geological Society's Collection. She has also furnished the accurate botanical details required in the preparation of certain pictorial period-restorations which form part of the scheme of exhibits for the new Museum.

Mr. S. W. Hester carried out fossil-collecting in Sheet 23 (Cockermouth) and also visited the new railway-cutting near Frome (Sheet 281). He prepared synoptic lists of the fossils collected from districts in Sheet 78 (Wakefield), 86 (Glossop), 87 (Barnsley), and 23 (Cockermouth), for the purpose of memoirs in preparation. He also did much work in the reorganization of the stored collections, and in the technical details connected with the preparation of specimens and mountings for exhibits to be shown in the new Museum.

Mr. W. Dewar spent six months of the year in the Lancashire Coalfield, collecting fossils, rock-specimens and mining information in the area of Sheets 75 (Preston) and 84 (Wigan), which involved visits to many underground workings. He also obtained geological information and a collection of fossils at the excavations for the New West Dock, Southampton, and he visited a boring for water near Westerham, Kent, obtaining there a collection of fossils and rock-specimens, with detailed information relating to the sequence of beds penetrated. Collecting was also done by him in districts within Sheets 167 (Dudley) and 182 (Droitwich). He has also assisted in the reorganization of the reserve-collections and in the preparation of various new exhibits.

Mr. S. W. Morgan has spent much time in assisting research workers, in preparing some of the sets of specimens despatched on loan for study, and in drawing up the lists of particulars relating to them, in addition to carrying out registration and technical work. The total loans during the year amounted to 7,412 specimens, of which 4,700 went to the Geological Survey Office in Manchester.

Many enquiries have been dealt with during the year, and assistance has been given to numerous research workers. Much time was spent in giving help to a number of foreign geologists, most of whom visited the Museum while present in London to attend the meeting of the British Association.

SCOTLAND.—During the year more than 1,800 specimens were collected. The fossils were chiefly obtained from the Coal Measures of Ayrshire (Sheets 14 and 15) and Northumberland (Sheets 8 and 10), and also include material collected by Mr. W. Manson from various sinkings and borings in the Scottish coal-fields. In addition, small sets of fossils were collected from the Old Red Sandstone of Shetland (Sheet 126) and from the Jurassic and Cretaceous rocks of Morvern (Sheet 52). The collecting from sections in the field was carried out by Messrs. Tait, Eckford, and Fisher.

The bulk of the material has been dealt with by Dr. J. Pringle, who, as in former years, has had occasional help from Prof. A. E. Trueman, D.Sc., and Prof. D. M. S. Watson, F.R.S. The fossil fishes from Shetland have been submitted to Prof. Watson for determination.

The collections of rocks and fossils were transferred to the new annexe in March, and the unpacking of the John Smith Collection was completed. Considerable progress has been made by Mr. E. M. Anderson in the registration of this large collection, and some of the specimens have already been borrowed by specialists for study.

An item of special interest to Scottish geologists is the acquisition of some choice examples of algal limestones from the Lower Carboniferous rocks of Roxburghshire. These, together with specimens of the associated fauna, were presented to the Geological Survey by Prof. E. J. Garwood, F.R.S., and it is proposed to place a part of the gift on exhibition in the Royal Scottish Museum.

Palaeobotany

During 1931 fossil plants have been identified from twelve one-inch Sheets, numbering 854 specimens.

Loans of plants have been made to Professor John Walton (16 specimens), Professor H. S. Holden (2 specimens), Dr. R. Florin (30 specimens), Miss E. Dix (55 specimens), and to Professor T. G. Halle (49 specimens), while the Kidson Collection continues to be used considerably both by British and foreign investigators. A number of prints of microphotographs of *Lepidodendron macconochiei* have been supplied to Dr. S. Williams, Glasgow University, who is describing the species.

In the Museum, work has been continued on the Coal Exhibit, especially in connexion with ' coal-balls ' and with the investigation of coals by microscopic and other methods. The work in hand is mainly concerned with the completion of this exhibit.

Dr. Crookall was given six month's instruction in field mapping by Dr. W. B. Wright in the Millstone Grit and Coal Measures of the Preston Sheet (75). During this period he collected 231 fossils and 54 rock specimens.

Petrography

The activities of the Petrographical Department during the past year have been mainly directed towards a review of the petrological collections preparatory to their rearrangement and removal to the new Museum at South Kensington. Rock-collection to provide fresh material for exhibition has been carried out extensively by rock-collectors and geologists. About 540 trimmed hand-specimens of typical rocks have been collected from North and South Wales, while minor collections of museum material have been made from the Isle of Purbeck, the Weald and

other districts. Progress has been made by the Petrographer and Miss Guppy in the arrangement of an exhibit to illustrate the rock-forming minerals, and by Mr. Richey in the preparation of an exhibit to illustrate Tertiary volcanic activity in the West of Scotland.

Miss Guppy with the assistance of the Petrographer completed the memoir dealing with Chemical Analyses of Igneous Rocks, Metamorphic Rocks and Minerals. The petrology of the Cheviot Hills has been completed (Sheets 3 and 5), and progress has been made with the petrology of that part of the English Lake District included in Sheet 23 of the map.

In Scotland, Mr. MacGregor has continued his work on the igneous rocks of Ayrshire (Sheet 14), and the Director has dealt with petrographic material collected by the surveyors from the Shetland Islands. Survey work was resumed in the region of Loch Sunart (Sheet 52) and has resulted in the collection of much material of great petrographical interest which will be dealt with in detail in due course. The department has been consulted freely by other Government Departments, public bodies and private individuals, reports on material submitted having been furnished to the Road Board, Mines Department, Forest Products Research Laboratory, City of Westminster, Imperial Bureau of Soil Science, etc.

The number of sliced rock-specimens and corresponding sections registered in the collection and housed for reference in the Petrographical Department in London is as follows:—

English and Welsh	15,887
Scottish	28,793
Irish	453
Foreign	3,119
Total	48,252

This represents an aggregate increase of 1,746 in the registered sliced specimens during the past year. Of the corresponding sections 1,151 were made by Messrs. Andrews and Hepple in the English office and 200 were registered to be made in the Scottish office, 1,352 in all. The remaining 395 were presented, the chief donors being Dr. E. Greenly, the Building Research Board, the Anglo-Persian Oil Co, and Sir John Flett. A series of rocks and corresponding sections collected by Col. English from the Dardanelles was registered and incorporated in the foreign collections.

Considerable progress has been made in the task of bringing the permanent catalogues of sliced rocks up to date.

During the year 1,279 rock-sections and 755 specimens were dispatched to various Survey officers in Scotland and elsewhere for study, and 37 rocks and 22 sections were loaned to private individuals.

Photography

Mr. J. Rhodes has been employed in taking photographs of geological interest to illustrate the geology of the Weald of Kent, Surrey, Sussex, the Yorkshire Coast and East Anglia, to the number of 409. These views are intended to illustrate the related regional exhibits in the new Geological Museum.

The number of negatives now registered is as follows :—

English photographs	5,729
Photomicrographs	1,858
Miscellaneous	2,461

Mr. Rhodes has made 1,057 prints from Survey negatives for incorporation in the reference-albums, including 74 chosen for reproduction in Survey memoirs. Lantern slides to the number of 120 have been made and added to the collection in process of formation.

Assisted by Mr. E. G. Radley, Mr. Rhodes has made 250 sepia-toned enlargements (24 in. by 18 in.) of geological subjects and more than 100 photomicrographs to illustrate the rock-forming minerals.

Chemistry

The number of analyses registered in this Department's records at the end of 1931 is as follows :—

English	349
Scottish	553
Irish	2
Welsh	55
Others	52
	1,011

Of these, sixteen have been completed during the year and four are still in progress. Twenty-three qualitative analyses have been carried out for Survey officers and many enquiries from various sources have been dealt with. Time has been devoted to the planning and lay-out of technical services in the laboratory of the new Museum.

Museum of Practical Geology

Apart from current cataloguing, registration and routine enquiries the Museum staff has been fully occupied with the planning and lay-out of the exhibits for the new Museum. A considerable number of sectional exhibits have been arranged, explanatory labels, diagrams and photographs have been prepared, and the specimens, selected from the existing collections, listed and stored in preparation for removal. The field collecting and photography necessary to fill up gaps in the collections are now in hand and a proportion of the work completed. Plans have been drafted for the preparation by outside artists and designers of

selected displays on modern lines and a certain number are already in various stages of completion. Throughout the work the staff has been in constant consultation with the officers of H.M. Office of Works regarding furniture, fittings and general planning.

No new research work on the gravitational and magnetic methods was undertaken but the field-results obtained last year were worked up and published.

The Library continues its normal expansion and continues to be used to an increasing extent by the public and research workers.

List of Donations during the Year 1931

Ainscouth, F., Esq.—Platiniferous iron-sand from near Bawbaw Hill, Sierra Leone.

Anglo-Persian Oil Co., Ltd.—81 micro-sections.

Beck, H., Esq.—Lapis beads from excavations at Ur.

Bell's Asbestos and Engineering Supplies, Ltd.—Two samples of chrysotile and one of crocidolite.

Bensusan, A. J., Esq., A.R.S.M., F.C.S., M.I.M.M.—Specimens of pimelite, baddeleyite, and samarskite with columbite from Minas Geraes, Brazil; also rocks from the diamantiferous area around Coromandel, Minas Geraes.

Blythe, Miss N.—Three specimens of marble from Palestine.

Bond, W. R. G., Esq.—Four glazed specimens of flint from Tincleton, Dorset.

Boulton, Professor W. S., D.Sc., A.R.C.Sc.—Two specimens of 20-inch cores from Windsor Street Gasworks, Birmingham (Borehole No. 2).

Calder, D., Esq.—Iron slag from Tannochy, Sutherlandshire.

Corin, Monsieur F.—Specimen of metamorphic andalusite-rock from Libramont, Belgium.

Davies, Professor Arthur Morley, D.Sc., A.R.C.Sc.—Specimen of Arngrove stone, from Amersham, Bucks.

Davis, A. G., Esq.—Set of mounted and named Microzoa from the Atherfield Clay, Gault and Upper Chalk of Surrey.

Edwards, R., Esq. (*per* H. Woods, Esq., F.R.S.).—Specimen of *Teredo* from the London Clay, 28 ft. 6 in. below the present ground-level in an excavation in Cheapside.

Edwards, W. C., Esq.—Two medallions of Vesuvius Lava moulded at San Sebastian during eruption of 1871.

Escobari, Max., Esq.—Series of volcanic ashes from La Paz, Bolivia.

French, A., Esq., M.I.M.E.—Series of freshwater lamellibranchs from the Coal Measures, about 15 feet above the High Hazels Coal of No. 2 pit, Thorne Colliery, near Doncaster, Yorkshire.

General Refractories, Ltd.—Moulding sands from Pickering, Yorkshire; Bramcote, and Warsop, Nottinghamshire; and Kidderminster, Worcestershire.

Greenly, E., Esq., D.Sc., F.G.S.—Series of specimens from the Upper Carboniferous " Red Measures " Conglomerate of Carnarvonshire, and 117 micro-sections.

Groves, J., Esq., F.L.S.—Specimen of limestone with artificially etched surface showing remains of *Clavator reidi* J. Groves, from the Middle Purbeck of Portisham, Dorset.

HERROUN, E. F., ESQ.—Series of choice specimens, mainly from the Silurian of Dudley and Malvern, presented in memory of his father, the late H. L. Herroun.

HILGER, MESSRS. ADAM, LTD.—A cleavage rhomb of calcite.

HOBLEY, C. W., C.M.G.—Two specimens and corresponding micro-sections from Griqualand Iron-stone Mines.

HORNER, M., ESQ.—Three specimens with Ostracods and *Cyrenae* from the Purbeck of Teffont Evias, near Salisbury.

HOWELL, G., ESQ., D.Sc., F.G.S.—Specimen of Manziono Deposit from Crater of Bracciana, near Rome.

ISLIP IRON CO., LTD.—Concretion from the Boulder Clay.

JACK, G. H., ESQ., F.S.A., M.I.C.E., F.R.I.B.A., F.G.S.—Specimen of *Orthoceras angulatum* Wahlenberg, from the Aymestry Limestone of Aymestry, Herefordshire.

JACKSON, H. S., ESQ.—Two cabochons in labradorite.

JOHNSTON, MISS M. S., F.G.S., F.R.G.S., F.Z.S.—Collection of fossils from various horizons, selected from her collection.

KELLY, L., ESQ.—Portion of a green prism of tourmaline.

KENDALL, PROFESSOR P. F., D.Sc., F.R.S., F.G.S.—Specimen of *Cryptangia woodi* Edwards and Haime, with *Cellepora*, from the Coralline Crag of Ramsholt, Suffolk.

KOZU, DR. SUKUSUKI.—Series of copper ores and associated rocks from Hitachi Mine, Ibareka Ken; and from the Ashio Mine, Japan.

MACHIN, T. M., ESQ.—" Eenie " or " Eyed " Coal from Bannockburn Main Coal, Denny, Stirlingshire.

MALLADRA, DR. C.—Ropy lava from the 1858 flow (Vesuvius).

MIDDLETON, SIR JOHN.—Large pebbles of colourless chalcedony from Cyprus.

MOORE, E. W. J., ESQ., B.Sc., A.I.C.—Three specimens of *Beyrichoceras hodderense* Bisat, from the base of the Pendleside Limestone (Zone B), near Ing Barn, Newton (near Clitheroe), Lancashire.

PENNANT, THE HON. ALICE DOUGLAS.—Whistling sand from Berth-Aur, near Llangwnadl, west coast of Lleyn Peninsular, Carnarvonshire.

PENROSE, J. D., ESQ.—Two samples of crude oil from roof of Langwith Colliery, Derbyshire.

POWELL, L. S., ESQ.—Halloysite from Elba.

REYNOLDS, PROFESSOR S. H., M.A., Sc.D.—Specimens from Loch Doon area, Galloway, Scotland.

SHANNON, DR. W. G. ST. JOHN, D.Sc.—4 micro-sections of rocks from Torquay district.

SHEPHERD, W., ESQ.—Limonite and iron-pan from Farnham, Surrey. Specimens of Ammonites and fossil wood from the Folkestone Beds of Farnham, Surrey.

STOCKFIELD, G. A., ESQ.—Large specimens of chrysotile from the Mashaba Asbestos Company's mine, Mashaba, Southern Rhodesia.

STUBBLEFIELD, C. J., ESQ., PH.D., D.I.C., A.R.C.Sc., F.G.S.—Two Echinoids from the Fuller's Earth (Sandgate Beds) of Copyhold Quarry, Redhill, Surrey; a primitive star-fish from the Llanvirnian (Hope Shales—*D. bifidus* Zone), near Hope Hall, Shropshire; and a specimen of *Orthoceras* cf. *sericeum* Salter from the Shineton Shales (*S. pusilla* Zone), Granham Moor Quarry, Habberley, Shropshire.

TEMPLEMAN, A., ESQ.—A large specimen of *Nematophyllum minus* M'Coy from the Carboniferous Limestone (S.), at a small quarry east of St. Helen's Chapel, Dalton in Furness, Lancashire.

Turner, J. Selwyn, Esq., B.Sc., F.G.S.—A collection of terrestrial Mollusca from beneath Clay-with-flints near Meopham, Kent.

Vevers, Dr. G. M.—Flint implement showing ice-scratches and fine patination, found 12 feet down in contorted flinty clay (? glacial) from Gaddesden, Herts.

Wade, A., Esq., D.Sc., F.G.S.—Series of specimens of hydrocarbon minerals from Australia, Poland, and South Texas.

Ware, W. D., Esq. (*per* Professor A. E. Trueman, D.Sc., F.G.S.).—Figured specimens of *Anthracomya warei* Dix and Trueman, and *Anthracomya* cf. *adamsi* Salter, from the Blackband Ironstone of Cefn Coed Colliery, Crynant, Glamorganshire.

Wilson, T. Stacey, Esq., M.D., B.Sc., F.G.S.—Four Liassic fossils from a glacial boulder at Penmaenmawr, Carnarvonshire; also a series of shell-remains from the Pleistocene (Glacial) of Gloppa, Shropshire.

Woodward, C. J., Esq., B.Sc., F.G.S.—A series of marine shells from the Glacial Gravels of Lilleshall, Shropshire, illustrative of his paper in the Reports of the British Association for the Advancement of Science (Birmingham Meeting), 1865.

Wyllie, B. K. N., Esq., M.A., B.Sc.—Series of lavas from Vesuvius.

Wyndham, Miss.—Ironstone, molybdenite and marble from New South Wales.

Zonolite Co. (U.S.A.)—Six grades of vermiculite (zonolite) from Libby, Montana.

John S. Flett,
Director.

II. DISTRICT REPORTS

(A)—ENGLAND AND WALES

1. SOUTHERN DISTRICT

HENRY DEWEY, District Geologist.
H. G. DINES, A.R.S.M., A.M.INST.C.E., Senior Geologist.
W. LLOYD, B.Sc.
F. H. EDMUNDS, M.A.
S. BUCHAN, B.Sc.
F. B. A. WELCH, B.Sc., PH.D.
} Geologists.

DURING the year field work was continued in the Sevenoaks map (Sheet 287) by Mr. Dines who trained Mr. S. Buchan in the Westerham district, and by Mr. Edmunds, who was assisted by Dr. Welch, in the area around Tonbridge. About one-third of the area has been surveyed.

Wealden Beds.—Mr. Edmunds and Dr. Welch have mapped the Ashdown beds, the Wadhurst Clay and the Weald Clay, and find that the strata are sharply folded in the manner characteristic of this part of the Weald.

Lower Greensand.—Mr. Dines has traced some sharp folds in the Hythe beds across the north of Knole Park: these folds trend south-east by east for a distance of 1½ miles. Mr. Buchan observed that in the Hythe beds near Westerham the folds trend west-south-west. He has separated the Sandgate beds from the Folkestone Sands.

Upper Greensand.—From Limpsfield eastwards the Upper Greensand thins from 30 feet to about 2 feet. Near Titsey hard bands of rock form a slight feature at the base of the Chalk escarpment, whereas eastwards this feature disappears with the hard beds which pass laterally into glauconitic clayey sand.

Pleistocene.—South of Limpsfield several miles of sewer trench were examined by Mr. Buchan: these exposed yellow or grey-brown stiff clay, sandy clay and sand with subangular blue and brown flints and pebbles from Tertiary Beds. The deposit is not uniform in composition and it is unbedded. Artifacts are said to have come from it but none could be found after long search.

A colour-printed edition of the Cirencester map (Sheet 235) is in preparation; the dry-proof being complete. For the greater part of the area the geology has been transferred from the Old Series maps, but a survey of the drift deposits was made by Mr. Dines,

who also revised some of the solid geology, especially in a small area near Andoversford. The Kemble Beds have been separately mapped around Cirencester.

We are indebted to Mr. Linsdall Richardson for the manuscript of the memoir. When published, this memoir and the memoir on Moreton in Marsh (Sheet 217) will contain a useful account of the geology of the Central and North Cotswolds.

Mr. Lloyd continued the survey of the Bridport map (Sheet 327) and gave Dr. Welch his field training in that district.

Inferior Oolite.—Mr. Lloyd finds that the re-survey, so far as it has gone, verifies the description of the Inferior Oolite by Mr. Linsdall Richardson,[1] who has examined a small area in detail. Many species new to the district have been collected, and will be considered in relation to a wider area when the formation has been further examined.

Forest Marble.—Dr. Welch was able to draw a boundary line for several miles between the Fuller's Earth and the Forest Marble by means of the fossil *Goniorhynchia boueti* which is recognisable in the ditch sections, and even in ploughed fields.

Cornbrash.—The Cornbrash of West Dorset has been dealt with by Dr. J. A. Douglas and Dr. W. J. Arkell.[2] Confirmation of the demonstration by these authors of a more widespread occurrence of the Upper Cornbrash than was supposed by S. Buckman[3] has been obtained by Dr. Welch.

The publication of six-inch geological maps of London having been approved, their preparation for the engraver was commenced. It is expected that a group will be published during 1932.

The survey of the Reigate map (Sheet 286) was completed in 1930; the engraved map has been coloured as a pattern for colour-printing, and the manuscript of the memoir is nearly complete.

Much of Mr. Dines's time was taken up in the early summer by his attendance at the Soils Correlation Committee's visits to many centres in England and Wales in which soil surveys are in progress (p. 24).

During the summer Mr. Edmunds was also withdrawn from normal surveying. He was deputed to co-operate with Mr. Bakewell of the Building Research Station in an investigation on the properties of Portland building stone. Much assistance was rendered by Mr. H. J. Sansom of the Bath and Portland Stone firms, and the thanks of the Survey are due to him.

Mr. Edmunds also collected rock specimens of the Wealden beds, and with Mr. Rhodes's assistance took 80 photographs for the Museum. Enlargements of these photographs, and a selection of the specimens, formed an exhibit at the Centenary Meeting of the British Association. At that meeting Mr. Dewey lectured on the

[1] *Proc. Cotteswold Nat. Field Club*, vol. xxii, 1929, parts 1 to 3.
[2] *Quart. Journ. Geol. Soc.*, vol. lxxxiv, 1928, p. 118.
[3] *Quart. Journ. Geol. Soc.*, vol. lxxxiii, 1927.

'Geology of the London Basin,' and he and Mr. Edmunds led several field excursions in the Home Counties.

The number of enquiries with regard to water supply, foundations of buildings, soils and sub-soils continues to increase. Many are important especially those relating to works undertaken by public bodies including the Ministry of Health, the Ministry of Transport, the Great Western Railway, the L. and N.E. Railway and the Southern Railway.

Much of Mr. Dewey's time is occupied by these enquiries. He visited, with Dr. Welch, the cuttings on the new section of the main line of the G.W.R. east of Frome, where the Kellaways Clays, the Cornbrash and the top of the Forest Marble were exceptionally well exposed. The resident engineer, Mr. Macdonald, gave valuable assistance in this work.

Mr. Dewey prepared an explanation for the Museum exhibits illustrating the geology of Cornwall, Devon and Somerset, and with Dr. Welch's help arranged several of the cases.

H. DEWEY.

2. WEST MIDLANDS AND BIGGLESWADE DISTRICTS

C. H. Dinham, B.A., District Geologist.
E. E. L. Dixon, B.Sc., A.R.C.Sc.
R. L. Sherlock, D.Sc., A.R.C.Sc.
R. W. Pocock, D.Sc.
T. H. Whitehead, M.Sc., A.R.C.Sc. } Senior Geologists.
T. N. George, M.Sc., Ph.D., Geologist.

AFTER a short interval, charge of the Midlands District reverted from Dr. Smith to Mr. Dinham in the summer of 1931; at the same time supervision of the Biggleswade area (Sheet 204), now being mapped on the six-inch scale for the first time, was taken over from Mr. Dewey. Dr. Robertson was transferred to the Scottish office early in the year, and no further revision work has been carried out in the South Wales Coalfield.

The Shrewsbury one-inch map (Sheet 152) is passing through the press, and the memoir will be ready for the printer before long. Certain six-inch maps in the Dudley Coalfield (Sheet 167) have been prepared or passed for publication. With the assistance of Mr. Edmunds, the memoir and map of Saffron Walden (Sheet 205) have reached the proof stage, and they will shortly be published.

Geological enquiries in great number concerning the Midlands and other areas have been answered by the staff. The copying and filing of records presented to the Survey has occupied a considerable time, and since the beginning of the autumn there has been much preparation of material for exhibition in the new Museum. In the earlier part of the year, Mr. Dinham was engaged chiefly on Scottish work, and the memoir on the Economic Geology of the Stirling and Clackmannan Coalfield, and two sheets of Vertical Sections, are now in the press.

West Midlands District

Six-inch revision of the original one-inch map was continued during the year in the country between Bridgnorth and Kidderminster (Sheet 167), and, as this area is well advanced towards completion, was extended southwards into the Droitwich Sheet (182) which contains most of that part of the Forest of Wyre Coalfield which still awaits re-survey. Dr. Pocock made progress in the coalfield around Billingsley, Hampton and Highley, while Mr. Whitehead continued investigation of the Trimpley anticline, the ground westward towards the Severn, and the Triassic rocks to the east. A further large area of Trias was mapped by Dr. George between Droitwich and Belbroughton.

Downtonian and Old Red Sandstone.—The outcrop of these rocks in the Trimpley anticline has been mapped by Mr. Whitehead to its southern extremity, about half a mile within the

Droitwich Sheet (182). They show a fairly obvious division into a lower group, in which red marls predominate enormously over sandstones and cornstones, and an upper group in which sandstones and cornstones are much more numerous, though still in smaller proportion than marl. These two lithological divisions correspond approximately to the stratigraphical divisions characterized respectively by the Downtonian fauna and by the *Pteraspis-Cephalaspis lyelli* fauna of the Lower Old Red Sandstone (Dittonian of W. W. King).[1] The readily recognisable Birch Hill or *Psammosteus* Limestones, consisting of 50 to 100 ft. of purple and green sandstones with numerous lenticles of cornstone, approximately mark the lithological change, and their top would appear to offer a more convenient boundary between the Downtonian and the Old Red Sandstone than the *Cephalaspis* Sandstone. The latter, taken as the basement bed of the Lower Old Red Sandstone by Mr. King,[2] seems to be only one of several lithologically similar beds, not easy to distinguish one from another in much-faulted ground. The possibility of change depends upon whether the fauna of the beds between the *Psammosteus* Limestones and the *Cephalaspis* Sandstone absolutely requires their inclusion in the Downtonian. From the accounts at present published[3] this does not seem to be the case.

Coal Measures.—Dr. Pocock reports that the most important disturbance in the coalfield area between Billingsley and Highley is the Brock Hall Fault, which runs north-eastwards from Bagginswood by Brock Hall to cross the River Severn at Hampton Loade; it displaces the outcrop of the base of the Keele Beds three-quarters of a mile and is estimated to have a south-easterly throw of 200 to 250 yards near Brock Hall. The combined throw of three principal faults found nearer to Highley Colliery is approximately the same in amount, but is in the opposite direction.

The group of purple marls with espley-like grits found amongst the Coal Measures north of Shatterford[4] has been traced by Mr. Whitehead southward beyond that village and through Eymore Wood. The Main Sulphur Coal appears to lie at the top of this group. Beds of the same type were seen in Seckley Wood west of the River Severn in the trench for a new pipe line along the Elan Aqueduct.

The Shatterford basalt has been traced by Mr. Whitehead to the bank of a brook in Eymore Wood, just over a mile south-west of Shatterford, where it is not more than 6 ft. thick. South of this brook[5] its characteristic feature is entirely absent from the topography.

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[1] King, W. Wickham, *Proc. Geol. Assoc.*, vol. xxxvi, 1925, p. 383.
[2] *Trans. Worc. Nat. Club*, vol. vii, 1921, p. 321.
[3] King, W. W., *Proc. Geol. Assoc.*, vol. xxxvi, 1925, p. 387.
[4] 'Summary of Progress' for 1930 (*Mem. Geol. Surv.*), 1931, p. 40.
[5] Cantrill, T. C., 'A Contribution to the Geology of the Wyre Forest Coalfield,' Kidderminster, 1895, p. 33.

Trias.—The Upper Mottled Sandstone of the Bunter and the underlying Pebble Beds were found by Dr. George to crop out in the area to the north of Catshill. The Pebble Beds of Chadwick and Brookhouse consist of the usual coarse, dull red or brown sandstones, with impersistent bands of conglomerate. The Upper Mottled Sandstone forms the low ground over which flow the headwaters of the Battlefield Brook. It is composed of a fine-grained, remarkably homogeneous, bright red, violently false-bedded sandstone, in which mottling is only slightly, if at all, developed.

Along the flanks of the pitching northern nose of the Droitwich syncline the Lower Keuper Sandstone is excellently displayed, especially in the high ground between Aston Fields, Bromsgrove, Catshill, and Fairfield, and between Elmley Lovett, Chaddesley Corbett, and Drayton. Nevertheless, it is difficult to determine any persistent succession of strata, and the usual three-fold grouping cannot be made. The Basement Beds are strongly conglomeratic in places, especially near Catshill, but quartz conglomerates are also present at a fairly high horizon, as near Worms Ash, and at Perryfields. The major thickness of the Sandstone is excessively false-bedded, and red, buff, or greyish-white in colour, but there are also developed at several horizons well-laminated crimson and purple fine-grained sandstones. The plant-bearing beds have been recognised near Bromsgrove.

The Red Marls of the Keuper present a monotonous succession, poorly exposed, of red, grey, and variegated marls, with occasional grey arenaceous layers, which seem to be without influence on the topography, are more common towards the base, and are frequently ripple-marked and rain-pitted; they are often associated with thin films and ribs of gypsum, and salt-pseudomorphs are abundant on some of their bedding-planes. The Arden Sandstone has not been recognised, and no real distinction can be drawn between the Upper and the Lower Marls. The Tea Green Marls are developed to a thickness of about 20 ft. along the scarp face of the Rhaetic to the east of Hanbury and Woodgate (Sheet 183).

Rhaetic.—The Bone Bed, with fish-teeth and scales, has been observed near Forest Farm, Hanbury (Sheet 183). It occurs in a calcareous sandstone containing abundant casts of lamellibranchs.

Glacial and Recent.—In the area surveyed by Dr. George, Glacial silts, sands, and gravels cap the hills to the east and north-east of Chaddesley Corbett, and to the south of Park Gate, at a level of 400 to 500 ft. above the sea. Their situation is anomalous, as they are evidently of fluviatile origin, and in some cases were deposited in still water. Outliers occur on Dodderhill Common, and at Hanbury Church. The drifts in the neighbourhood of Catshill appear to belong to a different series. The ridge between Wychbold Church and Impney, rising to 210 or 225 ft., is capped by a thin deposit of gravel that may possibly represent the Main or Fluvio-glacial Terrace of the Severn. Crutch Hill, and a

small outlier of gravel at Fibden, may be relics of the same platform. In Dr. Pocock's ground, much nearer the river, this terrace is represented by patches of coarse gravel south-east of Crateford, and in the valley east of Chelmarsh. At this last place the gravel is very similar to that at Eardington, 2 miles to the north-west, and contains pebbles, up to 18 in. in diameter, of Uriconian rhyolites, quartzite, and Carboniferous sandstone.

The more recent terraced valley-gravels, along the River Salwarpe, are extensively developed between Rashwood, Wychbold, and Upton Warren.

Biggleswade District

Continuing his work to the north of Royston, in the eastern half of the Biggleswade map (Sheet 204), Mr. Dixon finds that the Gault, though underlying considerable areas in the Bourn and Rhee valleys, is scarcely exposed. Exploitation of the Gault clay (for bricks and pipes) has been meagre, but the whole outcrop of the immediately overlying Cambridge Greensand, to depths of over 20 ft., has been dug over for phosphates (' coprolites '), mostly during the last century. Nevertheless, so completely has the ground since been smoothed that, except in a few places where unfinished workings have been abandoned, it would not readily be discovered from surface evidence that any excavations had been made, were it not for the local abundance of small phosphates and the patches of glauconitic marl derived from slurry-pans.

Owing to glacial erosion, and in marked contrast to what is found south of the Thames, the lower half of the Chalk runs out beyond the foot of the main scarp, and covers a wide area of low undulating ground that shows little or no feature at the junction with the Gault. The Chalk Marl, which forms the thin feather-edge of this outcrop, has been decalcified to such an extent that its soil near the junction is as clayey as that of the Gault.

The Totternhoe Stone has been followed through the low ground from Steeple Morden to Melbourn by means of its slightly projecting feature. On treatment with acid, debris of this rock from Kneesworth has yielded abundant fine glauconitic silt, with some arenaceous foraminifera. At Bassingbourn and Kneesworth the stone throws out strong springs.

Mr. Dixon considers that the newer of the two glaciations that are in evidence in the district[1] is of Magdalenian age; and he has mapped the position of its ice-front at maximum extension, and several ice-stands during the retreat.

Dr. Sherlock, working in the south-western part of the same one-inch map, reports that the valley of the Ivel from Henlow to Sandy is occupied by a broad gravel flat, reaching a maximum width of 3 miles at Biggleswade. On both sides of the flat the surface rises gently, the river gravel giving place to Drift gravel

[1] ' Summary of Progress ' for 1930 (*Mem. Geol. Surv.*), 1931, Part i, p. 37.

and clay, with small exposures of ' solid ' rock, but the Drift ends on each side in a scarp-like feature facing lower ground. South-east of Biggleswade, for example, the Drift extends through Topler's Hill (on the Great North Road), Dunton, and Eyworth, and forms a plateau looking east-south-east, across a plain of Gault and the waters of the upper Rhee. Towards the north-west the Drift is still more prominent, forming in fact the highest ground in the district. It extends across Old Warden railway-tunnel to beyond Moggerhanger, and overlooks the extensive plain of the Ouse, formed by Oxford Clay and river gravel. Behind this north-western main Drift ridge, the ground falls gently, and ' solid ' rock, represented by thin Lower Greensand resting on Oxford Clay, appears at the surface, chequered by patches of boulder-clay and occasional kame-like mounds of sand and gravel. This diversified country of undulating Lower Greensand, with flats of Oxford Clay and hillocks of drift between, makes perfect park-land, of which the mansions at Southill, Old Warden, Ickwell Bury, etc., have taken full advantage.

The Ivel gravel flat, in the middle of the area, is intensively cultivated by nurserymen for the supply of the London markets, and parts of the Lower Greensand outcrop can also be used in this way. The flats frequently have relics of loam on them, too indefinite to be picked out on a map, but of great importance to the nursery-man. A combination of dry climate and light soil causes the crops to be ready for market early in the season. From the geological point of view, these Ivel gravels are complex. The outer parts are evidently glacial and the inner part is river gravel, but it is difficult to find a dividing line, for the Glacial Gravels have been re-sorted to make the river gravels.

C. H. DINHAM.

3. YORKSHIRE DISTRICT

Headquarters: York

C. E. N. Bromehead, B.A., District Geologist.
D. A. Wray, Ph.D., M.Sc., Senior Geologist.
J. V. Stephens, B.Sc., B.Eng.
Wilfrid Edwards, M.A.
G. H. Mitchell, Ph. D., M.Sc., D.I.C. } Geologists.

CONSIDERABLE progress has been made with the mapping of the Wakefield (78) and the Barnsley (87) Sheets of the one-inch map; owing to the overlap of the six-inch maps, parts of the southern edge of the Leeds (70), the western edge of the Doncaster (88) and the northern edge of the Sheffield (100) Sheets have been included.

Coal Measures.—In the Wakefield Sheet Mr. Edwards, working in the northern half, has nearly completed the re-survey of the Coal Measures; the mining of coal is proceeding actively over all this area, so that much detailed information has been collected. At present the Beeston Bed is the most widely worked seam, and has been chosen for study by the local Coal Survey Committee for West Yorkshire. Other excellent seams are the Middleton Main (' Silkstone ') and Haigh Moor; a number of higher seams are now largely worked out in their best areas. Coal workings, chiefly in the Beeston and ' Silkstone ' beds extend eastwards under the Permian cover. Auger-boring has been employed to prove the position of faults in the Permian rocks over areas which have not yet been exploited. The faults proved in the Permian are expected to influence the underlying Coal Measures, although unfortunately not every fault in the latter is reflected in the overlying Permian.

The dominant north-easterly faults have been traced northwards almost to the boundary of the coalfield; a trough which lets down a narrow strip of the Beeston Bed Coal between lower measures runs across Leeds from Greenside, Wortley, past the Town Hall, in the direction of Harehills. The trough, which runs through Middleton and Skelton, can be traced north-eastwards to Halton, whence it is continued by a zone of intense faulting running through Cross Gates and Stanks in the direction of Barwick-in-Elmet. Temporary sections have enabled the outcrop of the Black Bed Coal to be mapped between Roundhay and Seacroft, while east of Cross Gates the Slack Bank Rock, a source of building and moulding sand, has now been accurately mapped, together with the Barcelona Coal below it and various coals above.

The highest Coal Measures so far examined crop out in the Castleford district. A band with marine fossils has been found at certain localities here; farther south it has been traced by Dr.

Wray from Haw Park to Walton and Sharlston. It is well exposed in the brick-pit at Sharlston West collieries and yields a varied fauna including goniatites and lamellibranchs; it is clearly the same bed as that already observed in the Barnsley Sheet at Monk Bretton.[1] The recognition of this index-horizon, usually known as the Mansfield Marine Bed, should prove of considerable value in correlating the measures in adjacent areas. Dr. Wray has also found a second marine band, yielding *Lingula sp.* at Nostell brickworks; it appears to be the local representative of the Shafton or ' Top ' Marine Bed of the country to the south.

The Mansfield Marine Bed occurs about 200 ft. above the Oaks Rock, a thick bed of fine even-grained yellow sandstone which covers a considerable area around Walton. The coals which occur above the Oaks Rock include the Clifton Low and Top Coals, the Sharlston Yard, Low and Top Coal and the Nostell Coal; they have all been worked out along the outcrops. The principal seams mined at the present time in the area south of Wakefield include the Middleton Main, Haigh Moor, Stanley Main and Winter coals. All these seams yield high grade domestic and industrial coals. Considerable revision of the old maps is called for in this area.

Mr. Stephens has been working in the south-west of the Barnsley map, round Thurgoland, Stainbrough, Pilley, Birdwell, Wortley and Tankersley, an area of Lower and Middle Coal Measures cut up by two intersecting systems of faulting into small rectangular blocks. The faults trend north-west and north-east; the latter appears to be the dominant system. Many of the coal and ironstone seams have been worked out and mining is now confined to the eastern part of the area, where a few coals are still worked.

The Penistone Flag series along the Thurgoland-Wortley escarpment consists of seven or eight thin beds of sandstone with intervening shale. Two *Carbonicola* bands have been discovered at outcrop; one above the bottom sandstone of the series and the other about 90 ft. from the top. There are, according to a bore record at Wharncliffe Silkstone Colliery, several more of these bands in the series.

A thin coal about 100 ft. above the Parkgate seam possesses a distinctive roof of black shale packed with lamellibranchs and ostracods. Exposures were found 700 yards north-west of Pilley, and also in the new road cutting at Sowell Bridge, 1,300 yards W.S.W. of Tankersley.

Dr. Mitchell was engaged in the south-eastern part of the Barnsley Sheet, mainly on Permian rocks, but Middle Coal Measures were mapped between Conisborough and Rotherham. The important system of north-east faulting known as the Don Faults, the number of somewhat impersistent sandstones, and the wide spread of alluvium in the Don valley combine to make the sequence of measures difficult to follow.

[1] Barker, W. R. and D. A. Wray, ' Marine Horizons in the Coal Measures of the Barnsley District,' *Proc. Yorks. Geol. Soc.*, vol. xxi, 1930, pp. 322-329.

South-east of the Don two sandstones, the Dalton and Wickersley Rocks, can be recognized with some degree of confidence, as both are well exposed beyond the faulted belt. In the original survey the wide outcrop of sandstone near Ravenfield was referred to the Wickersley Rock; it is now found that this is a separate sandstone, whose base lies about 300 ft. above that of the Wickersley Rock, and whose maximum thickness approaches 100 ft. The name ' Ravenfield Rock ' is proposed for this bed.

Permian.—The escarpment of the Lower Magnesian Limestone forms a bold feature from Edlington by way of Clifton and Maltby to near Carr. To the east of this the beds form a dip-slope with a steady dip in that direction. Oolites, pisolites and finely crystalline limestones, often thick-bedded, form the lowest beds of the Lower Limestone, with occasional reef masses carrying conspicuous bryozoa and lamellibranchs. The higher strata of the Lower Limestone (sometimes known as the Middle Limestone) consist of granular or minutely cellular beds which are extensively wedge-bedded. Building stone is quarried in the lower beds at Braithwell.

The Middle Marl, consisting of red marl with gypsum beds, crops out in Wadworth Wood, extending from there southwards to near Stainton and onwards to the ground lying east of Maltby Wood. On the west edge of Wadworth Wood at the junction of the Middle Marl with the underlying limestone a fine series of swallow holes is developed in the limestone.

The thin-bedded Upper Limestone forms an escarpment extending from Wadworth along the eastern edge of Wadworth Wood to near Wilsick Hall, where the escarpment is breached by a stream. Southwards by way of Wilsick Lodge the escarpment is poor and the Upper Limestone forms an inconsiderable feature.

C. E. N. BROMEHEAD.

4. LANCASHIRE DISTRICT

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R. Crookall, Ph.D.

THE Memoir on Sheet 85 (Manchester) has been published and the collection of mining information in Sheet 84 (Wigan) is now well advanced. In addition to the plans of abandoned mines deposited in the Mines Department, many others are preserved at the collieries and in the various mining offices of the district, and the work of examining them is heavy. The work on this Sheet was discontinued during the summer months to enable Messrs. Tonks and Jones to put in a three months field season in Scotland, and in the early part of the year Mr. Jones was engaged upon the Orkney memoir. Dr. Crookall was attached to the unit for a period of six months to receive training in field work, and was employed in the revision of a portion of Sheet 75 (Preston).

Previous to his visit to Scotland, Mr. Tonks was engaged upon the examination of cross-measure tunnels with the fossil collector, Mr. W. Dewar.

At Holland Colliery the *Carbonicola* bands above and below the Arley Mine and one above the Skelmersdale Seven Foot Mine were found, while, at Chisnall Hall and Welch Whittle collieries, tunnels in the lower part of the succession were examined. No features of outstanding interest were, however, noted, and the forms occurring in the *Carbonicola* bands have not yet been fully examined.

Much difficulty has been experienced in the north-western portions of the coalfield owing to the heavy faulting and the poorly exposed and recorded succession. In the Douglas valley around Parbold and Dalton the difficulties are accentuated by conflicting evidence and an abnormal succession in the Lower Coal Measures, which differ considerably from the equivalent strata in the better known area of Rossendale.

Mr. Jones, on his return from Scotland, mapped a small area about Winwick on the borders of Sheets 84 and 97 in order to obtain further evidence as to the limits of the Permian inlier, to the importance of which, as implying an extension of the workable coalfield, reference was made in the Summary of Progress for 1930.[1] The ground was, however, found to be heavily overlain by drift, except for outcrops of Bunter Sandstone on ridges about Winwick, and it will be impossible to attain to greater definiteness without boring. Incidentally the continuation into this area of the Man-

[1] p. 51.

chester Plain[1] was confirmed. It is here about 50 ft. above O.D. and carries a thin, fairly even, covering of sand.

The area around Mellor and Pleasington revised by Dr. Crookall is on the whole very ill exposed, although the highly tilted grits of the Blackburn district extend across it, forming prominent features. The actual grit beds can thus be thoroughly examined, but of the intervening shales there are few exposures. Marine fossils have, however, been found in a number of localities, and these serve to set limits to the possibility of error in the identification of the grits. A wide range of strata from the Wilpshire Grit to the base of the Lower Coal Measures is represented, and there is extensive faulting, so that the final interpretation of the geology of the large drift-covered areas is a matter of great difficulty.

W. B. Wright.

[1] Jones, O. T., 'The Origin of the Manchester Plain,' *Journ. Manch. Geog. Soc.*, vols. xxxix-xl, 1923-4, pp. 89-123.

EX BIBL. UNIV. EDINBURGEN.

5. CUMBRIAN DISTRICT

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F. M. Trotter, D.Sc., Senior Geologist.
S. E. Hollingworth, M.A., D.Sc.
W. C. C. Rose, M.Sc. } Geologists.

THE recall of the field staff at the end of September precluded the completion of the re-survey of Sheet 23 during 1931. Field work on the New Red Sandstone and the Coal Measures, however, is complete and most of the Lower Carboniferous and older rocks have been mapped, but certain areas require further attention, and many points relating to structure and correlation have yet to be considered.

During the year Mr. Eastwood completed the mapping of the Lower Carboniferous and older rocks to the east and north-east of Cockermouth. Dr. Trotter was centred on Uldale and was mainly engaged on the Skiddaw and Borrowdale rocks, while Dr. Hollingworth was principally employed on the metamorphic rocks of Skiddaw and Carrock Fell, and the Berrier area of the Borrowdale Volcanic Series. Mr. Rose completed his work on the drift-covered area of New Red Sandstone near Wigton and was then transferred to the older rocks about Embleton.

Skiddaw Slates.—Dr. Trotter finds that three lithological types may be recognized in the outcrop of Skiddaw Slates between Dash and the onset of the Borrowdale rocks to the north. They include (*a*) blue-black slates with rare, grey, silty bands such as occur on both sides of the valley of Dash Beck near Dash; (*b*) an arenaceous type—including striped grey and blue slate and siltstones with flags and sandstones up to 6 in. thick—which outcrops on the northern and southern flanks of Great Cockup; and (*c*) the Watch Hill Grit which, in the gill between Burn Tod and Great Cockup, consists of beds that show rhythmic depositional cycles from coarse grit through massive sandstone and siltstone to striped slate. A sequence such as that shown by (*c*) is usually regarded as representing the order of deposition from below upwards, but since in our case the cycle is, in some places, in the reverse order, we assume these beds to be there overturned.

The rocks as a whole dip to the south-south-west, but wrinkling on this sheet dip is frequently displayed and occasionally results in vertical beds or, more rarely, in northerly dips. Little or no cleavage is shown by the arenaceous types, but is pronounced in the argillaceous strata. The strike of the cleavage, like that of the bedding, is east-north-east but its "dip" is invariably southwards.

Near Dash the Slates enter the metamorphic aureole of the Skiddaw Granite. Spots of cordierite are developed throughout

the argillaceous layers, which in places also show crystals of chiastolite.

Farther to the east Dr. Hollingworth is able to distinguish a similar series of rocks to those in Dr. Trotter's ground. In the metamorphic aureole all the types are well developed, but to the east and south-east of it, argillaceous types predominate except in the crags north of Mungrisdale where flags with sandstones are faulted in.

In the south-western part of Sheet 23, in the area mapped by Messrs. Eastwood and Rose, although some blue-black shales are present, the chief types in the Skiddaw Slates are striped slates with a series of sandstones and grits that give rise to Watch Hill. The general dip is to the north-north-west at high angles but many of the beds are seen to lie in tightly packed folds. In a few places a strong cleavage is developed, inclined in the same direction, but at greater angles than the bedding; as a rule, however, the beds are uncleaved.

The Skiddaw Granite and its Metamorphism.—Dr. Hollingworth reports that only minor modifications have been made in the boundaries of the principal outcrop of the granite in the valley of the Caldew, and in those of the related body of griesen in Grainsgill. The granite is not well exposed, but, apart from slight differences in grain size and in the proportion of biotite, appears to exhibit no important macroscopic variations. Occasional coarse pegmatitic patches have been noted and some aplitic veins are present.

Dr. Rastall's conclusion[1] that the principal variations in the metamorphic types result from original variations in composition, has been confirmed, for, in addition to the persistence of the banded and predominantly siliceous types across the aureole, the metamorphic equivalents of the argillaceous types show variations in appearance (such as in the relative abundance of cordierite spots to chiastolite-andalusite crystals) that are traceable from the outer to the inner margins of the aureole on both sides of the granite. Indeed, the metamorphism may be considered to have brought out differences in composition that are by no means obvious in the unmetamorphosed rocks. For instance, some spotted argillaceous types in which chiastolite crystals are rare or absent in the outer part of the aureole retain this character throughout, whereas in others chiastolite appears in advance of the spotting and remains plentiful in the spotted (cordierite) hornfels up to the granite.

Diorites.—A number of igneous intrusions have penetrated the Skiddaw Slates in the area between Bassenthwaite Lake and Cockermouth and have been mapped by Messrs. Eastwood and Rose. Most of them appear to be sills parallel to the general stratification of the Slates. They vary in thickness from a foot or

[1] 'The Skiddaw Granite and its Metamorphism,' *Quart. Journ. Geol. Soc.*, vol. lxvi, 1910, pp. 116-140.

two to hundreds of feet, and, in length of outcrop, from a few yards to a quarter of a mile. One of the largest, about 400 ft. thick, is worked for road metal and setts by the Cumberland Granite Co., at Close Quarry, Embleton. There is another large intrusion on the Golf Course, Embleton, and smaller sills at Fell End and Slate Fell, 2 miles east of Cockermouth, and on Watch Hill and Elva Hill. Those at the last two localities are associated with the Watch Hill Grit; the rest are in shales. In both rock types the amount of contact alteration is trifling.

Borrowdale Volcanic Series.—It was thought at one time that the coarsely porphyritic type of lava, such as is developed on the lower part of Eycott Hill, was restricted to the bottom of the Borrowdale Volcanic Series. It is now clear that such rocks come in more than once, for, in the Binsey region, mapped by Dr. Trotter, such lavas near the base of the series are followed by several tuffs between lavas that are dominantly fine grained, which are in turn overlain by a thick series of lavas, including flows of the coarse Eycott type, at two horizons.

The general direction of strike hereabouts is easterly with dips to the north of from 65 to 75°. If there be no repetition by faulting or folding—of which we have no evidence here though there appears to be some overfolding farther north—the thickness of Borrowdale rocks in the neighbourhood of Binsey cannot be less than 7,000 ft.

In the south-eastern corner of the map, near Berrier, the lavas centred about Eycott Hill form a regular succession of strike features separated by peat-filled depressions. Dr. Hollingworth reports that about 20 flows, totalling some 2,000 ft. in thickness, may be recognized. In this isolated outcrop of the volcanic series lavas predominate, but there are a few subordinate bands of tuff in the lowest 500 ft. where the well-known basic lavas with large crystals of felspar also occur. Above these are a number of lavas containing smaller phenocrysts of felspar and pyroxene in varying proportions, but with distinctive characters that serve to identify individual flows. Higher again, lavas with still smaller phenocrysts occur between dark, compact, non-porphyritic, fluidal banded lavas similar to those found along the Caldew above the coarsely porphyritic lavas of Linewath.

T. Eastwood.

6. NORTHUMBERLAND AND DURHAM DISTRICT

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W. Anderson, M.Sc. }

DURING the field season of 1931, the Northumberland unit was, as before, engaged in two distinct areas. Lower Carboniferous ground in Upper Redesdale (Sheet 8), was revised by Mr. Anderson, while Mr. Burnett and Mr. Eyles continued their work on the Coal Measures round Seaton Sluice and Blyth (Sheet 15). In the autumn Mr. Eyles moved westward to Ponteland, in Sheet 14. Mr. Fowler was engaged mainly in office work on the preparation of the Rothbury memoir (Sheets 9 and 10), but at intervals attended boring operations in the Broomhill Coalfield and north of Morpeth.

Cementstone Group.—Normal Cementstone strata are seen in the Cottonshope Burn west of Dour Hill, and again in the Sills Burn north of Featherwood. It is of interest to note that Mr. Anderson found limy ribs with Rhynchonellids and other small marine fossils not far below the top of the Group, a feature common to other districts south and west of the Cheviots.

Fell Sandstone.—On either side of the high ground running from Crigdon Hill to Dour Hill parallel step-faults, down south and trending W. by S., bring in the Fell Sandstone, the ridge ending in a bold escarpment facing west. As usual, false-bedded sandstone and massive grits prevail, with a 6-ft. bed of conglomerate in the Sills Burn, 300 yards below Featherwood, containing pebbles of grit and quartz up to 4 in. in diameter.

Scremerston Coal Group.—South of the Fell Sandstone ridge most of the Upper Rede valley is covered by a broad belt of Scremerston measures. As usual in this part of the country, this is divided by the Redesdale Limestone into a lower, more or less estuarine or freshwater series, and an upper group with many good marine limestones. The ground is heavily drift-covered, the only good sections being along the Sills Burn. In the lower division entomostracan shales with thin coals and fireclays are fairly common. Several of the coals have been worked for local use, but the only one of any consequence is the Bush Coal, a 2-ft. seam wrought around Hillock farm. This lies about 250 ft. below the Redesdale Limestone and, somewhat higher in the series, a 10-in. seam was opened out ¼ m. S.S.W. of Dyke Head. On the opposite side of the Rede valley, another 2-ft. coal, possibly on the

same horizon as the Bush Coal, has been got round Rookenpit-houses.

The upper division appears along the Stewartshield Burn, with the four limestones above the Fourlaws on the ridge east of the stream; all are of better quality than their more easterly equivalents in the Penchford Burn, 5 m. to the E.S.E. North of these outcrops a new, and highly fossiliferous, exposure of the Redesdale Limestone has been noted in the headwaters of Ramseys Burn.

Millstone Grit.—An important boring for water has been started in Millstone Grit strata north of Morpeth. The cores, 15 in. in diameter, are being examined by Mr. Fowler, who has collected a number of marine fossils (a first record for Northumberland), from shaly partings between the grits. This material has been submitted to Dr. Pringle, who has recognized several typical members of the Nebraskan fauna, specimens of *Pterinopecten whitei* (Meek) being particularly good; it may be remembered that a similar American facies was first noted nearly 25 years ago by Wheelton Hind in a Scottish Millstone Grit assemblage.[1] No goniatites have so far been got.

Coal Measures.—Much new information has been obtained by Mr. Burnett from a detailed inspection of the mining plans of the extensive Hartley and Backworth workings, near the coast and north of the Tyne. Coal has been wrought here for centuries, and little is now left of such well-known thick coals as the High Main, Main, Yard and Low Main, lying near the surface. The lower seams, now being worked, are thinner, and are at times affected by 'stone' or 'dirt' partings. Sandstone 'wash-outs' are also known (e.g. that in the Bensham Coal near the coast between Whitley Bay and Seaton Sluice), but some compensation is afforded by abnormal thickenings in other parts of the district. Faults abound, and tend to run in groups, within which the coal can only be got with difficulty. The two chief disturbances, the Ninety-Fathom and Briardene Dykes, both down north, are more isolated, but with the former the belt of 'tender' and steeply inclined coal on either side is fully 100 yds. broad, and for that reason the Dyke has never been actually proved.

Several small whinstone dykes are known, varying from 3 to 17 ft. in thickness. They run more or less parallel to the W. by N. faults, frequently branching and coming to an end abruptly, either in a lateral or vertical direction; these features can be studied at leisure in the excellent shore-section at Collywell Bay.

Mr. Eyles reports that the 'wash-out' in the Low Main Coal known north of the Wansbeck, round Woodhorn Demesne[2], is continued for nearly three miles south of the river, in the undersea workings of the Camboise and Mill Pits. There is reason to

[1] Hind, Wheelton, 'On the Lamellibranch and Gasteropod Fauna found in the Millstone Grit of Scotland,' *Trans. Roy. Soc. Edin.*, vol. xlvi, 1909, pp. 331-359.

[2] 'Summary of Progress' for 1926 (*Mem. Geol. Surv.*), 1927, p. 56.

believe that the pre-Glacial course of the R. Blyth ran eastwards from Bebside to the sea, bores south of the river-mouth having gone down nearly 60 ft. below sea-level before rock-head was reached.

Glacial.—Two boulder-clays are known along the Stewartshield Burn, which runs southwards to the Rede, in Sheet 8. The upper clay, yellowish and sandy, belongs to the later ice-movement, coming from the west. The lower clay, stiff and bluish-coloured, contains a fair proportion of Cheviot volcanic rocks, and may mark an earlier, more southerly, trend of the same ice-sheet, though Dr. Smythe is more inclined to ascribe it to a preliminary and independent glaciation from the Cheviot massif.[1]

Mr. Eyles reports that the extensive alluvial flat known as Prestwick Carr, N.E. of Ponteland, is flanked by discontinuous beds of Glacial sand, culminating at the north-west in an esker-like ridge of coarse sand and boulders, the latter often of Carboniferous Limestone. Sand mounds recur three miles south-east of the Carr, in low ground parallel to the Ouse Burn. Resting as they do on boulder-clay, all these deposits are evidently of late-Glacial date, associated with the waning of the ice-sheet.

R. G. CARRUTHERS.

[1] Smythe, T. A., *The Vasculum*, vol. xvii, 1931, p. 86.

(B)—SCOTLAND

1. WEST HIGHLAND DISTRICT

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DURING the past summer, Messrs. L. H. Tonks and R. C. B. Jones were transferred temporarily from the Lancashire unit for field work in the above district. Dr. M. Macgregor and Dr. J. Pringle also spent a short time in the field.

The ground mapped lies within Sheet 52, and includes the greater part of Morvern, together with smaller areas around Strontian, and to the north of Dalelia in Moidart. Moine Schists, north of Dalelia, and north of Strontian, were surveyed by Mr. A. G. MacGregor and Mr. Ross respectively, and those of Morvern by Messrs. Richey, Simpson, Tonks and Jones. The greater part of the Morvern-Strontian Granite has been mapped, the surveyors concerned being Messrs. Richey, A. G. MacGregor, Kennedy and Jones. The Mesozoic sediments and Tertiary lavas of Western Morvern were investigated by Messrs. Simpson and Tonks.

Moine Schists and Injection-Gneisses.—North of Dalelia there are narrow belts of pelitic and psammitic schists strongly injected by pegmatitic material. A sharp fold closing to the north in the neighbourhood of Lochan Meall a'Mhadaidh is a striking feature of the district.

North of Strontian, beyond the northern margin of the Morvern-Strontian Granite, regional injection in an intense form has resulted in the production of a belt of augen-gneiss continuous with that of Sgùrr Dhomhnuill.[1]

In Morvern, psammitic and pelitic schists in three broad north-south belts[2] constitute the country rocks from the Carna Pelitic[3] eastwards to the granite margin. A western belt of psammitic schists with concordant quartzose veins lies between Carna and Beinn Iadain. It is separated by a belt of pelitic injection-gneisses about two miles wide from an eastern belt of psammitic gneiss with marked pegmatitic injection. The more easterly psammitic belt contains an epidotic zone, well seen at Cnoc an Dubh on the shore of Loch Teacuis. The more easterly psammitic belt includes numerous narrow bands of injection-gneisses. Here, as in the

[1] 'The Geology of Ben Nevis and Glen Coe' (*Mem. Geol. Surv.*), 1916, p. 88.
[2] The distribution of these belts has been roughly indicated by Dr. J. F. Scott: *see* 'The General Geology and Physiography of Morvern, Argyll,' *Trans. Geol. Soc. Glasgow*, vol. xviii, pt. i, 1928, pp. 152-3.
[3] Simpson, J. B., *in* 'Summary of Progress' for 1921 (*Mem. Geol. Surv.*), 1922, p. 89.

Dalelia district,[1] sillimannite and porphyroblasts of muscovite are locally characteristic of pelitic and semi-pelitic gneisses respectively. Tourmaline is also developed locally and sometimes forms crystals several inches in length.

Minor Intrusions Older than the Morvern-Strontian Granite.—Occasional small sheets or dykes of garnetiferous amphibolite cut by quartz veins are met with, particularly in the main pelitic belt of Morvern. Individual intrusions are often represented by lines of lenticles.

Sheets and subordinate dykes of lamprophyre or appinite, so abundant around Glen Moidart,[2] are of frequent occurrence in Morvern. They are later than the regional metamorphism and injection, though some of them have been sheared.

Morvern-Strontian Granite-complex.—This complex occupies an area of over 80 sq. m., extending from the head of Loch Sunart southwards and eastwards to the Great Glen Fault along Loch Linnhe. Previous writers[3] have realised that it includes two granite types. It has now been ascertained that these types mark two distinct intrusions and that a third intrusion is also present around most of the granite-schist contact. The three types consist, in order of intrusion, of: (1) marginal tonalite, (2) porphyritic granodiorite, and (3) a centrally situated, pink biotite-granite.

The contacts between the different types are everywhere sharp, except in the north-east where the junction of tonalite and granodiorite is ill-defined. Southwards, in Sheet 44, the biotite-granite was found to cut across the earlier intrusions and to come into direct contact with the schists.

Minor Intrusions Younger than the Morvern-Strontian Granite.—The granite-complex and the adjacent injection-gneisses and schists are cut by many minor intrusions. These include: (1) sheets and dykes of porphyritic granite, belonging to the Morvern granitic suite; (2) dykes of porphyrite, felsite, etc., of Lower Old Red Sandstone types; (3) dykes and elongate bosses of coarse quartz-dolerite, possibly belonging to the Permo-Carboniferous suite; (4) a great series of camptonite and monchiquite dykes trending west to north-west; and (5) north-west to north-north-west Tertiary dykes of tholeiite and olivine-dolerite.

Mesozoic Sediments.—Trias cornstones and conglomerates, hitherto unrecorded, are found by Mr. Simpson to cover a considerable area between the lava-outliers of Beinn Iadain and Beinn Ithearlan.

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[1] MacGregor, A. G. and W. Q. Kennedy, *in* 'Summary of Progress' for 1930, Part ii (*Mem. Geol. Surv.*), 1931, p. 64.

[2] MacGregor, A. G., *ibid.*, p. 64.

[3] Lee, G. W., *in* 'The Pre-Tertiary Geology of Mull, Loch Aline and Oban' (*Mem. Geol. Surv.*), 1925, p. 46; and J. F. Scott, *op. cit.*, p. 154.

The Cretaceous rocks usually rest upon Lower Lias, but in the Allt Frogach, south-east of Barr, Cenomanian Greensand with a thin basal bed of glauconitic conglomerate directly overlies Moine Schists. On Beinn Iadain it is now proved by fossil evidence that the whole of the fine-grained desert sandstone occurring below silicified Chalk with flints[1] is of Cenomanian age.

Tertiary Lavas.—In western Morvern the Tertiary lavas of the well-known outliers and those forming the lower part of the main lava-escarpment on the south-western side of the Loch Arienas valley are normal olivine-basalts of Mull plateau type, excepting a thick flow near the base. This flow contains large sparse felspar phenocrysts and the lower, solid part, is markedly columnar. This columnar portion is without doubt lava, and not a sill, for the overlying slag likewise contains large sporadic felspar crystals. The flow must have covered a wide area, as it extends for 6 miles right along the main lava-escarpment and occurs in the outliers of Beinn na h'Uamha and Beinn Iadain. It has also been observed along the south-east side of Loch Aline in Sheet 44.

Economics.—The well-known lead veins of Strontian and Lurga[2] are associated with east-west crush-lines which often affect earlier camptonitic dykes of the same trend. Both dykes and veins are later than the Morvern-Strontian Granite but are cut by Tertiary dykes. The crush-lines and associated veins are found to extend westwards to Loch Moidart. There would thus appear to be no connexion between the veins and the granite.

J. E. Richey.

[1] Manson, W. and J. B. Simpson *in* 'Summary of Progress' for 1922 (*Mem. Geol. Surv.*), 1923, p. 96.

[2] Wilson, G. V., 'The Lead, Zinc, Copper and Nickel Ores of Scotland,' Special Reports on the Mineral Resources of Great Britain (*Mem. Geol. Surv.*), 1921, pp. 82-83.

2. SHETLAND

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} Geologists.

Metamorphic Rocks.—A sufficient area of the central and southern portions of the Mainland has now been completed by Messrs. Wilson, Robertson, Haldane and Knox to allow the following summary to be given.

The country rocks consist of a sedimentary series of siliceous and argillaceous schists and gneisses together with bands of crystalline limestone. Intruded into these are large masses, sills and dykes of basic and acid igneous rocks. The basic members are now mainly represented by rocks rich in hornblende and occur in all stages from coarsely crystalline masses to fine-grained schists. As far as can be made out they appear to have been intruded either just prior to, or at an early stage in the period of foliation. The acid rocks consist of granites with associated pegmatites and aplites and have been intruded at various periods. In some instances they appear to have been injected during the foliation, and have given rise to areas of permeation and injection that are approximately parallel to the strike of the country rocks. The most interesting of the later granites occurs on the western side of the area and has been traced from near Quendale to Spiggie. It is seen in Burra and can be followed northwards through the small islands to Sand Voe. It then crosses over by the east side of Bixter Ness to the head of Aith Voe. Over most of the outcrop the rock is not foliated, but in Oxna, Hildasay and adjacent small islands signs of a slight foliation along a N.N.W. direction have been noted. When fresh, the rock is pinkish in colour. It usually contains numerous large porphyritic felspar phenocrysts and is exceedingly rich in epidote.

Among the more important lines of movement mention may be made of a well-defined fault that has been shown by Dr. Robertson to repeat a considerable part of the succession. It trends almost north-and-south and has been traced northwards from near Wadbister to Flugarth in the vicinity of Swining Voe.

The examination of the ground shows that a general and gradual increase in the degree of metamorphism of the sedimentary series takes place in a westerly direction. This is indicated by the state of crystallization of the rocks, and by the nature of the minerals present. The rocks of the most easterly group are phyllites and grits which become more schistose to the west, where they also contain thick belts of limestone and bands of hornblende schist.

In the Dunrossness peninsula Mr. Knox records the presence of several bands of chloritoid schist. In the rocks of this group garnet, staurolite and andalusite are noticed only in the vicinity of igneous masses; for instance andalusite occurs near the granite at Channerwick.

Passing westwards, we come to a series of micaceous and siliceous schists that includes an injection or permeation zone up to 1½ miles in width. This zone contains large masses and sheets of a foliated muscovite-microcline-oligoclase granite which, as far as can be ascertained, does not appear to have much effect on the general metamorphism. Next comes a series of siliceous and micaceous schists with numerous bands of limestone such as those at Whiteness and in Weisdale. Biotite is a prevalent metamorphic mineral in this belt of rocks. Small garnets occur throughout and are numerous in certain bands of silvery mica-schist associated with the Weisdale Limestones.

The next stage in the metamorphic sequence is manifested by the occurrence of belts of rock rich in staurolite and small garnets. The most easterly of these extends from Russa Ness along the ridge of Weisdale Hill to the north end of the West Kame. An interesting fact about this band is that the staurolite is mainly replaced by an aggregate of muscovite and quartz. Westwards from here the garnets increase in size, and kyanite is developed together with staurolite, which is now often in a fresh condition. In this part of the area two large intrusive masses of coarsely crystalline hornblende-rock have been noted by Mr. Haldane in the neighbourhood of Gonfirth, and Dr. Robertson has observed a further area of granitic injection to the east of Aith.

In the exteme north of the Mainland, Dr. Phemister finds two series of metamorphic rocks. The western one consists of a variable group of orthogneisses that are rich in hornblende and usually contain small felspar augen. Where exposed on the west coast they are mainly granitic and contain infolded sheets of basic and ultrabasic rocks. The boundary between the two series conforms to the strike of the foliation, and the rocks on both sides are highly sheared, though no definite line of movement was observed.

The eastern series comprises a thick siliceous group followed eastwards by interbanded garnetiferous muscovite-schists and hornblende-schists. Intruded into the series are sheets of greenstone and serpentine that in places are highly sheared. The eastern part of the succession is complicated by the presence of numerous lines of dislocation that are roughly parallel to the strike, which is slightly east of north. The highest beds appear to be grey and green schists with thin limestones that are exposed in a northerly-pitching syncline west of Lanyar Taing. A north-east line of movement runs through Flugarth, and has caused the rocks on the south-east to be displaced eastwards for a distance of one mile.

Mr. Allan has completed the mapping of Yell, and finds that the rocks in the southern part are divided into three groups by two

north-and-south lines of movement. In the eastern belt the rocks have a low dip to west or west-north-west, and consist mainly of micaceous injection gneisses with a few thin sills of foliated granite and many thin lenticles of hornblende-schist. The central area is triangular in shape, and is bounded on the west by a line of movement that crosses from Whale Firth to Hamna Voe. The rocks dip north-west and show the following succession :—garnetiferous biotite-gneiss with a thick band of epidote-hornblende-schist; silvery mica-schist with garnets; the Arisdale quartzite; silvery mica-schist with garnets; and a wide belt of garnetiferous biotite-gneiss to the north-west. The western belt is occupied by a fairly uniform series of vertically disposed siliceous mica-schists with occasional small garnets. Between Ness of Sound and Westsandwick the schists are traversed by numerous dykes and strings of coarse red pegmatite, while bands are permeated by granitic material.

Old Red Sandstone.—The mapping of the sediments of this age in the south-east part of Shetland has been completed by Mr. Knox. During the course of the work a thorough search of the fossiliferous horizons has been made by Mr. Eckford, and specimens containing fish remains have been obtained from the following localities in the Brindister Flags: (1) the east side of Sumburgh Head, (2) the Point of Laward, north-east of Grutness, (3 and 4) Ness of Sound and Shingly Geo, previously recorded by Dr. T. M. Findlay,[1] (5) a geo 400 yds. south of Shingly Geo, (6) the north-east corner and midway along the east side of Mousa.

Further collecting was done at the two localities at the Voe of Cullingsburgh in Bressay, and specimens of a small phyllopod referable to *Estheria membranacea* were obtained from a locality just north of Bressay lighthouse. This form had previously been recorded from near Lerwick.[2] It is a fossil with a very wide range, and is prevalent in the Rousay group of the Orkney flagstones.

A small area of the Walls Sandstone was mapped by Mr. Wilson. Much of the rock is in a highly crushed and indurated condition, but a thin bed of blue flags rich in fragmentary plant remains was noted on the shore about a quarter of a mile south-east of Bixter.

The granitic intrusion of Muckle Roe is found by Mr. Haldane to be cut by a great number of acid and basic dykes. Of special interest are certain devitrified spherulitic felsites in which the nuclei of many of the individual spherulites are beautiful skeletal crystals of sanidine.

G. V. Wilson.

[1] Findlay, T. M., 'The Old Red Sandstone of Shetland, Part I,' *Trans. Roy. Soc. Edin.*, vol. liv, Pt. 3, 1926, p. 560.

[2] Murchison, Sir Roderick I., 'On the Succession of the Older Rocks in the Northmost Counties of Scotland,' *Quart. Journ. Geol. Soc.*, vol. xv, 1859, p. 413.

III. SECTIONAL REPORTS

1. PALAEONTOLOGICAL DEPARTMENT

In London

F. L. KITCHIN, Sc.D., PH.D., F.R.S., Palaeontologist (District Geologist).

C. P. CHATWIN, M.Sc., Assistant-Palaeontologist (Senior Geologist).

C. J. STUBBLEFIELD, PH.D., A.R.C.Sc., Geologist.

In Edinburgh

J. PRINGLE, D.Sc., Assistant-Palaeontologist (Senior Geologist).

A. ENGLAND AND WALES

The chief items of work carried out during the year in this Department have been summarized above, in the Report of the Director (p. 30). Few points have arisen of such scientific interest that there is need to record them here.

In addition to the presence of the usual guide-fossils common in various horizons of the Chalk, shown in the area of Sheet 287 (Sevenoaks) surveyed by Mr. Buchan, a characteristic there of the Planus Zone was found to be the frequent occurrence of *Spondylus spinosus* (J. Sowerby). An interesting record from the soft chalk of the Terebratulina Zone is a small form of *Goniomya*, a new species, apparently the first noted in England from this horizon. An incomplete example of *Romaniceras* was also obtained from this zone.

It is of interest to note the common occurrence of two species of *Pecten* in the Hythe Beds exposed in a pit S.E. of Westerham, Kent. While these two forms, *Pecten* (*Syncyclonema*) *orbicularis* J. Sowerby and *Pecten* (*Chlamys*) *robinaldinus* d'Orbigny, are present there in relatively great abundance, only two other fossils have been found with them at this locality.

The results of Mr. Chatwin's examination of the Lower Devonian material recently collected from the area of Sheet 350 (Torquay), and his revision of old collections, are in general agreement with Dr. F. R. C. Reed's useful studies of the fossils of these beds in the Torquay area.[1] In view of the frequency of their occurrence in the Lower Devonian and of their utility in stratigraphical work, certain examples of *Spirifer* have been figured on the plates prepared for the Torquay Memoir.

[1] Reed, F. R. C., 'Notes on the Fauna of the Lower Devonian Beds of Torquay,' *Geol. Mag.*, 1920, pp. 299-306; and 1921, pp. 313-324.

In the course of selecting Cambrian fossils for the zonal stratigraphical exhibits in the new Museum, Dr. Stubblefield had occasion to examine specimens of *Olenus nuneatonensis,* described in 1886 by G. Sharman from the Stockingford Railway Cutting.[1] This species has apparently never been figured and has escaped the notice of recent workers. Dr. Stubblefield finds that it belongs to Ulrich and Resser's genus *Irvingella,*[2] of which two species have been described from the Upper Cambrian of Wisconsin and the Ozarkian of Novaya Zemlya. Other species are known from America, but this occurrence constitutes the first record from Britain; its horizon appears to be within the Outwoods Shales (Maentwrog).

During his field-collecting in Cumberland, Mr. S. W. Hester obtained specimens from a marine band in the Whitehaven Sandstone of Pow Gill, 2½ miles S.W. of Wigton, representative of a fauna which gives some indications of its position in the Coal Measures. There are the goniatites *Homoceratoides jacksoni* Bisat and an *Anthracoceras* of the group of *A. hindi* Bisat, which suggest a correlation with Skipsey's Marine Band of Scotland and the general horizon of the Gin Mine of Staffordshire and the Mansfield Marine Band of Yorkshire. Mr. Hester's collection includes various other Mollusca characteristic of this horizon, as well as the fish-spine *Listracanthus wardi* A. S. Woodward.

The following specimens in the Museum have been figured, described, or mentioned in publications:—

IN THE PALAEONTOGRAPHICAL SOCIETY'S VOLUME FOR THE YEAR 1929.

(Published 1931).

A Monograph of British Corallian Lamellibranchia. (Part iii).

By DR. W. J. ARKELL, M.A., B.Sc., F.G.S.

Chlamys (Aequipecten) midas (*Damon*), pl. xi, figs. 19-21, p. 115 (3 specimens).
Lima (Plagiostoma) zonata *Arkell,* pl. xii, figs. 1, 1a.
Trigonia blakei *Hudleston,* pl. xii, fig. 9, p. 77.

A Monograph of the Ammonoidea of the Gault. (Part viii).

By DR. L. F. SPATH, F.G.S.

Dipoloceras equicostatum *Spath,* pl. xxxii, figs. 11a, b, p. 364.
,, evansi *Spath,* pl. xxxii, figs. 18a, b, p. 353; and text-fig. 115e, f, p. 349.

[1] Appendix II, 'On the new species *Olenus nuneatonensis* . . .,' in A. Strahan, 'On the Rocks surrounding the Warwickshire Coal-Field and on the Base of the Coal-Measures,' *Geol. Mag.*, 1886, pp. 565, 566.

[2] In C. D. Walcott, 'Cambrian Geology and Palaeontology, V, No. 2, Cambrian and Lower Ozarkian Trilobites,' *Smithsonian Miscell. Coll.*, vol. lxxv, No. 2, 1924, p. 58, pl. x, fig. 3.

Stoliczkaia *cf.* dispar (*d'Orbigny*), pp. 331, 332 (3 specimens).
,, dorsetensis *Spath, var.* compressa Spath, p. 338.

A Monograph of the Fossil Macrurous Crustacea of England. (Part vii).

By Mr. H. Woods, M.A., F.R.S., F.G.S.

Homarus longimanus (*G. B. Sowerby*), pl. xxv, fig. 5; pl. xxvi, fig. 3, p. 90.

A Monograph of the British Cambrian Trilobites. (Part vi).

By Mr. P. Lake, M.A., F.G.S.

Macropyge chermi *Stubblefield,* pl. xv, fig. 5, p. 125.
Conokephalina invita (*Salter*), pl. xvi, figs. 4-9, p. 129 (4 specimens).
,, abdita (*Salter*), pl. xvi, figs. 10-15, p. 131 (5 specimens).
Solenopleura variolaris (*Salter*), pl. xviii, figs. 1-5, p. 139 (4 specimens).
,, applanata (*Salter*), cit. explanation of pl. xvii, fig. 3, p. 137.

In the Quarterly Journal of the Geological Society, Volume LXXXVII.

Ambocoelia *Hall and certain similar British Spiriferidae.*

By Dr. T. Neville George, M.Sc., F.G.S.

Crurithyris unguiculus (*J. de C. Sowerby*), pl. iii, figs. 5, 6, p. 52 (2 specimens).

The Tuedian Beds of Northern Cumberland and Roxburghshire East of the Liddle Water.

By Prof. E. J. Garwood, M.A., Sc.D., F.R.S., F.G.S.

Modiola lata *Portlock,* p. 143 (2 specimens).
,, macadami *Portlock,* p. 143.

VII. Appendix—*Brachiopoda of the Tuedian Beds of Northern Cumberland.*

By Miss H. M. Muir-Wood, M.Sc., F.G.S.

Derbyia ambigua *Muir-Wood,* p. 146.

Some Non-Marine Lamellibranchs from the upper part of the Coal Measures.

By Miss E. Dix, M.Sc., F.G.S., and Prof. A. E. Trueman, D.Sc., F.G.S.

Anthracomya phillipsi (*Williamson*), pl. xvi, fig. 2, p. 185 (3 specimens).
,, *aff.* phillipsi (*Williamson*), p. 199.

Anthracomya warei *Dix and Trueman*, pl. xvii, figs. 12a, b, p. 181.
,, *cf.* warei *Dix and Trueman*, pl. xvii, fig. 13.
,, *aff.* warei *Dix and Trueman*, pl. xvii, fig. 15.
,, *cf.* adamsi *Salter*, pl. xvii, fig. 14, p. 183.
,, sp., *cf.* pringlei *Dix and Trueman*, pl. xvii, fig. 17, p. 199.
,, sp., *cf.* calcifera *Pruvost* non *Hind*, pl. xvii, fig. 18, p. 199.
Naiadites sp., text-figs. 6a-c, p. 192 (17 specimens).
,, *cf.* producta (*Brown*), text-figs. 8a, b, p. 200 (2 specimens).
Cf. Naiadites elongata *Hind*, text-figs. 8c-e, p. 200 (3 specimens).

Additional Fossils from the Cambrian Rocks of Comley, Shropshire.

By Dr. E. S. Cobbold, F.G.S.

Polyzoon, *gen. et sp. indet.*, pl. xli, fig. 15, p. 498.

The Upper Great Oolite, Bradford Beds, and Forest Marble of South Oxfordshire, and the succession of Gastropod Faunas in the Great Oolite.

By Dr. W. J. Arkell, M.A., B.Sc., F.G.S.

Astarte fimbriata *Lycett*, pl. xlix, fig. 8, p. 598.
Epithyris bathonica *S. Buckman, var.* transversa *Arkell*, pl. xlix, figs. 14, 14a, 15, 15a, p. 600 (5 specimens).
,, bathonica *S. Buckman, var.* alta *Arkell*, pl. xlix, figs. 16, 16a, p. 600.
Nerinea eudesi *Morris and Lycett*, pl. l, figs. 1, 5, 6, p. 617 (3 specimens).
Isocyprina sp., p. 598 (2 specimens).

In the Annals and Magazine of Natural History, Volume VII, Tenth Series.

A Review of the British Species of the Asaphidae.

By Dr. F. R. C. Reed, M.A., F.G.S.

Asaphus powisi *Murchison*, pp. 443, 444 (10 specimens).
Isotelus tyronensis *Reed*, pp. 445-447 (13 specimens).
,, intermedius *Portlock*, p. 448 (2 specimens).
Homotelus? scutalis (*Salter*), pp. 448, 449 (5 specimens).
Basilicus peltastes *Salter*, p. 451.
Brachyaspis rectifrons (*Portlock*), pp. 452-454 (6 specimens).
Megalaspis? sp., pp. 454, 455 (2 specimens).
Asaphellus homfrayi (*Salter*), p. 457.
Ogygites? scutatrix (*Salter*), pp. 459, 460 (3 specimens).
Niobella selwyni (*Salter*), p. 464 (7 specimens).
Platypeltis crofti *Callaway*, pp. 464, 465 (2 specimens).
Ptychocheilus radiatus (*Salter*), p. 465 (2 specimens).
Niobe (Niobe) peltata (*Salter*), p. 466.

IN THE ANNALS AND MAGAZINE OF NATURAL HISTORY, VOLUME VIII, TENTH SERIES.

Hydroconophora *and* Hydrokerion : *Two new Genera of Cretaceous* Hydractiniidae.

By PROF. J. W. GREGORY, D.Sc., LL.D., F.R.S., F.G.S.

Hydrokerion sherborni *Gregory*, pl. xix, fig. 4, p. 480.

IN THE GEOLOGICAL MAGAZINE, VOLUME LXVIII.

The Millstone Grit of Gower.

By MISS E. DIX, M.Sc., F.G.S.

Posidoniella *aff.* rugata *J. W. Jackson*, pp. 533, 541.
,, sp.
Lingula mytiloides *J. Sowerby*
Reticuloceras reticulatum (*Phillips*), *mut.* γ Bisat (= *mut.* superbilingue *Bisat*).
Homoceratoides divaricatum (*Hind*), p. 534.
Pterinopecten sp.
Cordaites sp.
Homoceras proteum (*Brown*)
Posidoniella sp.
Eumorphoceras bisulcatum *Girty*, p. 541.

IN THE PROCEEDINGS OF THE GEOLOGISTS' ASSOCIATION, VOLUME XLII.

The Geology of the Ordovician and Valentian Rocks of the Shelve Country, Shropshire.

By DR. W. F. WHITTARD, D.I.C., A.R.C.Sc., F.G.S.

Palaeura sp. nov., p. 340 (2 specimens).

IN THE TRANSACTIONS OF THE ROYAL SOCIETY OF EDINBURGH, VOLUME LVI.

XXXI.—*The British and Belgian Carboniferous Bellerophontidae.*

By DR. JOHN WEIR, M.A., F.G.S.

Bellerophon corriei *d'Orbigny*, pl. i, figs. 4a, b, p. 787.
,, minor *Portlock*, pl. i, fig. 7, p. 789 (2 specimens).
,, tenuifascia *J. de C. Sowerby*, pl. i, fig. 9, p. 789 (5 specimens).
,, tenuifascia *Portlock*, non *J. de C. Sowerby*, pl. i, fig. 8, p. 790 (3 specimens).
,, sowerbyi *d'Orbigny*, pl. ii, figs. 6-8, 11a-c, 12, p. 790 (7 specimens).

Bellerophon costatus *J. de C. Sowerby*, pl. ii, figs. 17-19, p. 797 (10 specimens).
,, costatus *J. de C. Sowerby, var.* martini *de Koninck*, pl. iii, fig. 3, p. 799.
,, randerstonensis *Weir*, pl. iii, figs. 11, 13a, b, p. 801 (6 specimens).
,, monensis *Weir*, pl. iv, figs. 1a, b, p. 801 (4 specimens).
,, *cf.* monensis *Weir*, pl. iv, figs. 2-4, p. 802 (4 specimens).
,, wrighti *Weir*, pl. iv, figs. 7a, b, p. 804.
,, scalifer *de Koninck*, pl. iv, figs. 10, 11 a-c, p. 805 (2 specimens).
,, sulcatulus *de Koninck*, pl. v, fig. 2, p. 806.
,, tangentialis *Phillips*, pl. v, figs. 10a, b, p. 809 (4 specimens).
,, maximus *Weir*, pl. vii, fig. 1, p. 812.
,, anthracophilus *Frech*, p. 795.
,, recticostatus *Portlock*, p. 808.
Waagenella rectistriatus *Weir*, pl. v, figs. 11a, b; pl. ix, fig. 26, p. 815 (2 specimens).
Bucaniopsis interlineatus (*Portlock*), pl. ii, fig. 23, p. 825.
,, undatus (*R. Etheridge jun.*), pl. iv, figs. 15a, b, p. 826 (5 specimens).
,, imbricatus *Weir*, pl. vii, figs. 4a, b, 13, p. 833 (4 specimens).
,, hibernicus *Weir*, pl. vii, figs. 10, 12, p. 828 (4 specimens).
,, tenuis *Weir*, pl. vii, fig. 11, p. 831 (7 specimens).
,, exilis *de Koninck*, pl. viii, figs. 7a, b, p. 818 (6 specimens).
,, decussatus (*Fleming*), pl. viii, fig. 15, p. 821 (2 specimens).
,, concinnus *Weir*, pl. ix, fig. 24, p. 824 (6 specimens).
,, roscobiensis *Weir*, p. 823 (8 specimens).
,, densistriatus *Weir*, p. 825.
,, striatus (*Fleming*), p. 831.
,, penneystonensis *Weir*, p. 834.
Euphemus anthracinus *Weir*, pl. ix, figs. 20, 21, p. 852 (18 specimens).
,, spiralis (*Phillips*), pl. ix, figs. 27a, b, p. 855.
,, koninckí *Weir*, p. 844 (3 specimens).
,, d'orbignyi (*Portlock*), p. 844 (2 specimens).
,, urei (*Fleming*), pp. 847, 849 (18 specimens).
,, jacksoni *Weir*, p. 853 (4 specimens).
,, multilira *Weir*, p. 855.
,, portlocki *Weir*, p. 855.
Tropidocyclus oldhami (*Portlock*), pl. viii, figs. 18a, b, p. 838 (2 specimens).
,, oldhami (*Portlock*), *mut.* caledonicus *Weir*, p. 840.

IN THE MEMOIRS AND PROCEEDINGS OF THE MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY, VOLUME LXXV.

A Redescription of the Known British Ordovician Species of Calymene (*s.l.*).

By MR. J. SHIRLEY, M.Sc.

Synhomalonotus murchisoni (*Salter*), pl. i, figs. 5-7, p. 14 (5 specimens).
Calymene duplicata (*Murchison*), pl. i, figs. 8-10, p. 18 (3 specimens).
,, cambrensis *Salter*, pl. i, figs. 11-14, p. 20 (4 specimens).
,, planimarginata *Reed*, pl. ii, fig. i, p. 22.
,, caractaci *Salter*, pl. ii, figs. 4-6, p. 25.
,, brevicapitata *Portlock*, pl. ii, figs. 9, 10, p. 28.
,, quadrata? *W. B. R. King*, pl. ii, fig. 11, p. 31.
,, sp., pl. ii, figs. 2, 3, p. 4 (2 specimens).

IN THE PROCEEDINGS OF THE YORKSHIRE GEOLOGICAL SOCIETY, VOLUME XXII.

On the Occurrence of a British Coal Measure Goniatite in Missouri, U.S.A.

By MR. W. S. BISAT, F.G.S., MISS C. DUNCAN, M.A., AND MR. E. W. J. MOORE, B.Sc.

Homoceratoides jacksoni *Bisat*, p. 3.

Notes on some recent deep borings at Huddersfield.

By DR. D. A. WRAY, M.Sc., F.G.S., AND MR. S. MELMORE, B.Sc., F.G.S.

Carbonicola recta *Trueman*, pl. iii, fig. 3, p. 44.
,, pseudacuta *Trueman*, pl. iii, fig. 4, p. 41.
,, ornata *Trueman*, pl. iii, fig. 6, p. 41.
Anthracomya lenisulcata *Trueman*, pl. iii, figs. 5, 5a, p. 43.
,, prisca *Trueman*, pl. iii, figs. 7, 7a, p. 45.

IN THE NATURALIST.

Anthracoceras hindi, *Bisat, showing unusual ornament.*

By MISS C. DUNCAN, M.A.

Anthracoceras hindi *Bisat*, text-figs. i, ii, pp. 81, 82.

IN BRITISH MUSEUM (NATURAL HISTORY)—THE VERTEBRATE FAUNAS OF THE ENGLISH EOCENE, VOLUME I.

From the Thanet Sands to the Basement Bed of the London Clay.

By DR. E. I. WHITE, F.G.S., F.Z.S.

Odontaspis cuspidata (*Agassiz*), *praemut.* teretidens *White*, pp. 6, 22 (8 specimens).
,, macrota (*Agassiz*), *praemut.* striata (*Winkler*), pp. 6, 12, 22 (13 specimens).
,, rutoti (*Winkler*), p. 22.
,, sp., p. 5.
Albula sp. nov. ?, p. 5.
Squatina prima (*Winkler*), p. 13.
Phyllodont teeth, p. 13.
Vertebrae of shark, p. 22.

IN MEMOIRS OF THE GEOLOGICAL SURVEY, ENGLAND AND WALES.

The Geology of Manchester and the South-East Lancashire Coalfield.

Chapter VI.—*Palaeontology.*

By DR. W. B. WRIGHT, M.R.I.A., M.INST. M.E., F.G.S.

Carbonicola subconstricta (*J. de C. Sowerby*), text-fig. 46A, p. 134.
,, *aff.* communis *Davies and Trueman*, text-fig. 46B (2 views), p. 134.
,, pseudorobusta *Trueman*, text-fig. 47A, p. 135.
,, binneyi *W. B. Wright*, text-figs. 47B, C, p. 135 (2 specimens).
,, boltoni *W. B. Wright*, text-fig. 48 (2 views), p. 137.
,, os-lancis *W. B. Wright*, text-fig. 50A, p. 139.
,, os-lancis *W. B. Wright*, *var.* pectorata *W. B. Wright*, text-fig. 50C, p. 139.
,, *aff.* similis (*Brown*), text-fig. 50B, p. 139.
,, rhomboidalis *Hind*, text-fig. 50D, p. 139; text-fig. 52B, p. 141.
,, ovalis (*Martin*), text-fig. 50E, p. 139.
,, elliptica *W. B. Wright*, text-figs. 51A, B, p. 140 (2 specimens).
,, cycloquadrata *W. B. Wright*, text-fig. 51C, p. 140.
,, retrotracta *W. B. Wright*, text-fig. 52A, p. 141.
,, carissima *W. B. Wright*, text-fig. 52C, p. 141.
,, affinis *Davies and Trueman*, text-fig. 53B, p. 142.
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,, aquilina (*J. de C. Sowerby*), text-fig. 53E, p. 142.
,, faba *W. B. Wright*, text-fig. 54 (2 views), p. 143.
,, radiata *W. B. Wright*, text-fig. 56D, p. 146.
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,, concinna *W. B. Wright*, text-fig. 56F, p. 146.
,, fulva *Davies and Trueman*, text-figs. 57A, A^1 (2 views), p. 147.
,, atra *Trueman*, text-figs. 57B, B^1 (2 views), p. 147.
Anthracomya modiolaris (*J. de C. Sowerby*), text-fig. 49A, p. 138.
,, insignis *Davies and Trueman*, text-fig. 49B, p. 138.
,, sp., *intermediate between* A. insignis *Davies and Trueman and* A. curtata (*Brown*), text-fig. 49C, p. 138.
,, richfordi *W. B. Wright*, text-figs. 49D, D^1 (2 views), p. 138.
,, curtata (*Brown*), text-fig. 49E, p. 138.
,, fisheri *W. B. Wright*, text-figs. 49F, F^1 (2 views), p. 138.
,, pulchra *Hind*, text-figs. 55A, B, p. 145 (2 specimens).
,, cymbula *W. B. Wright*, text-fig. 56A, p. 146.
,, oblonga *W. B. Wright*, text-fig. 56B, p. 146.
,, librata *W. B. Wright*, text-fig. 56C, p. 146.
,, hindi *W. B. Wright*, text-fig. 59, p. 150.
Cytherella foveolata *W. B. Wright*, text-figs. 58, p. 149 (3 specimens).

IN MEMOIRS OF THE GEOLOGICAL SURVEY. SUMMARY OF PROGRESS OF THE GEOLOGICAL SURVEY OF GREAT BRITAIN AND THE MUSEUM OF PRACTICAL GEOLOGY FOR THE YEAR 1930, Part iii.

I.—*Some Upper Carboniferous Corals from South Wales.*

By DR. STANLEY SMITH, M.A., F.G.S.

Zaphrentis postuma *S. Smith*, pl. i, figs. 1-9, pp. 4-6.
,, sp. nov., pl. i, figs. 12a, b, p. 2.

? Caninia cornucopiae *Michelin*, pl. i, figs. 10a, b, p. 7.
Cyathaxonia *cf.* rushiana *Vaughan*, pl. i, figs. 11a, b, p. 9.
Emmonsia parasitica (*Phillips*), p. 10 (4 specimens).

IX.—*The Non-Marine Lamellibranchs of the Upper Carboniferous of Yorkshire and their Zonal Sequence.*

By Dr. D. A. Wray, M.Sc, F.G.S., and Prof. A. E. Trueman, D.Sc., F.G.S.

Carbonicola *aff.* aquilina (*J. de C. Sowerby*), pl. v, figs. 1a, b, p. 83.
,, *aff.* concinna *W. B. Wright*, pl. v, figs. 2a, b, p. 83.
,, *aff.* phrygiana *W. B. Wright*, pl. v, figs. 3a, b, p. 83.
,, *aff.* retrotracta *W. B. Wright*, pl. v, figs. 4a, b, p. 83.
,, ovalis (*Martin*), pl. v, figs. 10a, b, p. 77.
,, *aff.* ovalis (*Martin*), pl. v, fig. 11, p. 77.
,, sp. nov. ?, pl. v, figs. 5a, b, 6a, b, 7a, b, p. 75 (3 specimens).
Anthracomya *cf.* rubida *Trueman*, pl. v, fig. 8, p. 86.
,, *cf.* oblonga *W. B. Wright*, pl. v, fig. 12, p. 86.
,, sp., text-figs. 2a, b, (2 views), p. 79.
Naiadites sp., text-fig. 1, p. 76.

In Arkiv För Zoologi, utgivet av K. Svenska Vetenskapsakademien, Band 22A. No. 3. Stockholm.

South American Graptolites with special reference to the Nordenskiöld Collection.

By Dr. O. M. B. Bulman, B.Sc., A.R.C.Sc., D.I.C,, F.G.S,

Orthograptus *cf.* calcaratus (*Lapworth*), *var.* acutus (*Lapworth MS.*) *Elles and Wood*, text-figs. 23a-c, p. 53.

In the Proceedings of the United States National Museum, Volume LXXVIII, Art. 4, Washington, D.C.

Cambrian Bivalved Crustacea of the Order Conchostraca.

By Dr. E. O. Ulrich, F.G.S., and Dr. R. S. Bassler.

Indiana dermatoides (*Walcott*), p. 75.
Beyrichona spp., pl. vii, figs. 36, 37 (2 specimens).

B. Scotland

During the summer Mr. D. Tait visited several sections of Liassic and Cretaceous rocks in Morvern and obtained a representative suite of fossils. At Beinn Iadain he made a careful measurement of the section first described by Judd, and by digging exposed the junction between the Lias and the Cenomanian Greensand. A preliminary examination of the fossils by Dr. Pringle suggests that the beds immediately below the white silicified Chalk

are of Cenomanian age. From the Chalk, Judd recorded *Belemnitella mucronata* (Schloth.), but no additional examples of this fossil were obtained by Mr. Tait.

Mr. Eckford again visited the Shetland Islands and was successful in finding several new fossiliferous beds in the Old Red Sandstone. At Sumburgh Head he secured some good examples of fish-remains; at two localities on Mousa a number of fish-plates and scales were collected, while on the cliffs near Bressay lighthouse a dark shaly band was found by him to contain *Estheria membranacea* (Pacht) in abundance. The fish-remains have been submitted to Prof. D. M. S. Watson, F.R.S., for examination.

In the Sanquhar Coalfield Mr. W. D. Fisher obtained several species not previously recorded from Skipsey's Marine Band in this area. Amongst these may be mentioned *Metacoceras costatum* (Hind) and *M.* cf. *perelegans* Girty. In company with Dr. Pringle he searched a marine band, discovered by Mr. D. Tait in 1913 low down in the Coal Measures of Polneul Burn, and additional specimens of a new species of *Spirifer* were secured. The *Spirifer,* which is associated with *Buxtonia scabricula* (Mart.) and other shells, appears to be related to *S. pennystonensis* George, from Coalbrookdale.

In the material collected by Mr. Fisher from the Coal Measures of Northumberland, Professor A. E. Trueman has identified several species of *Carbonicola* hitherto unrecorded from that coalfield.

Reference has been made in the Report of the Director (p. 30) to the transfer of the collections of rocks and fossils to the annexe. This building has proved a great boon to the staff and to research workers alike, and the additional space made it possible to unpack the John Smith Collection before the beginning of field work. It was not practicable, however, to withdraw any member of the staff from his normal duties to undertake the registration of that collection, but through the help given by Mr. E. M. Anderson, progress in this work has been made and about 3,000 fossils have been registered. In addition, Mr. Anderson's wide knowledge of the localities from which much of the material was collected has been of considerable assistance when doubts arose as to the precise stratigraphical horizon of specimens.

The Survey Collections have been further enriched by a set of specimens presented by Professor E. J. Garwood, F.R.S. The gift includes choice examples of algal limestones from the Lower Carboniferous of Roxburghshire and of their associated fauna. A number of specimens will be placed on exhibition in the Royal Scottish Museum.

The following fossils have been figured in publications :—

IN THE TRANSACTIONS OF THE ROYAL SOCIETY OF EDINBURGH, VOLUME LVI.

XXXI.—*The British and Belgian Carboniferous Bellerophontidae.*

By DR. JOHN WEIR, M.A., F.G.S.

Bellerophon hiulcus (*Mart.?*) *J. de C. Sowerby*, pl. i, fig. 6, p. 787.
,, anthracophilus *Frech*, pl. i, figs. 13, 14, p. 793.
,, sowerbyi *d'Orbigny*, pl. ii, figs. 9, 10, p. 790.
,, *cf.* randerstonensis *Weir*, pl. iii, figs. 4, 6a-c, p. 801.
Bucaniopsis densistriatus *Weir*, pl. ii, figs. 14, 15, p. 824.
,, tenuis *Weir*, pl. vii, fig. 7, p. 831.
,, striatus (*Fleming*), pl. vii, fig. 17, p. 829.
,, exilis (*de Koninck*), pl. viii, fig. 11, p. 818.
,, decussatus (*Fleming*), pl. viii, fig. 16, p. 821.
Tropidocyclus oldhami (*Portl.*), *mut.* caledonicus *Weir*, pl. viii, figs. 20a, b, p. 839.
Euphemus urei (*Fleming*), *mut.* ardenensis *Weir*, pl. ix, figs. 9-12, p. 850.
,, urei (*Fleming*), *mut.* hindi *Weir*, pl. ix, figs. 16a-c, p. 849.

IN THE JOURNAL OF GEOLOGY, VOLUME XXXIX.

Studies on the Morphology of the Heterostraci.

By DR. H. C. STETSON.

Thelodus taiti *Stetson*, text-fig. 3, p. 146.

IN THE PROCEEDINGS OF THE YORKSHIRE GEOLOGICAL SOCIETY, VOLUME XXII.

On the Occurrence of a British Coal Measure Goniatite in Missouri, U.S.A.

By MR. W. S. BISAT, F.G.S., MISS C. DUNCAN, M.A., AND MR. E. W. J. MOORE, B.Sc.

Homoceratoides jacksoni *Bisat*, pl. i, figs. 2a, b, p. 3.

F. L. KITCHIN.

2. PALAEOBOTANICAL WORK

Plants have been identified during the year from twelve one-inch Sheets. The numbers of specimens from each Sheet is given in brackets: 8 (17); 9 (120); 10 (54); 16 (17); 20 (6); 23 (120); 31 (60); 44 (24); 75 (60); 78 (70); 87 (80); 231 (226). In addition, a number of fossil plants have been determined from boreholes and various other sources, British and foreign, for outside workers.

Two specimens of *Scolecopteris* from the Kidston Collection (Nos. 6983, 7018), which appeared to show structural features, were loaned to Professor H. S. Holden for investigation. Unfortunately, no structure could be discerned in the preparations made.

The usual assistance has been given with the palaeobotanical portions of memoirs at present being prepared for and passing through the press, and help has been afforded to research workers as required. Three demonstrations were given on various aspects of coal. These were to the South London Botanical Institute, the Geologists' Association and the Chelsea Polytechnic Geological Field Club.

Work has been continued on the Coal Exhibit, for the Museum, including the diorama of a coal forest. In connexion with this exhibit, generous aid has been forthcoming from the Fuel Research Department, who have provided (a) preparations by Mr. J. Lomax illustrating the making of thin slices of coals, (b) others by Mr. C. A. Seyler showing the etching method and its results, and (c) an X-ray photograph of coal by Mr. C. Norman Kemp. The Coal Survey Laboratory at Sheffield also kindly undertook an investigation of samples of coals provided by the Palaeobotanist from each of the pits now working in the Kent Coalfield. It was found, however, that in only one case did the samples contain spore-bearing bands.

An interesting collection of plants was made and forwarded by Dr. Murray Macgregor from the Coal Measures of Inninmore, Sound of Mull.

The Palaeobotanist spent six months of the year in the Lancashire Coalfield, receiving instruction in stratigraphy and six-inch mapping from Dr. W. B. Wright. While there, he had the opportunity of examining the whole succession from the base of the Millstone Grit to the Lower Coal Measures. A number of new plant localities in the Millstone Grit were found, as well as marine and *Carbonicola* bands.

Continued assistance has been received from Mr. W. D. Ware, who is making a systematic collection of plants and animals from the South Wales Coal Measures.

The following specimens have been figured, described or mentioned in publications:—

IN THE PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY OF LONDON, SERIES B, VOLUME CCXIX.

On the Spines, Sporangia and Spores of Psilophyton princeps, *Dawson, shown in Specimens from Gaspé.*

By PROFESSOR W. H. LANG, F.R.S.

Psilophyton princeps *Dawson*, p. 423, pl. 27, figs. 1-12 (Kidston Collection No. 107).
Psilophyton sp., p. 428, pl. 27, figs. 13, 14 (Kidston Collection, No. 112).

Contributions to the Knowledge of Lower Carboniferous Plants. Part III.

By PROFESSOR JOHN WALTON, M.A., D.Sc.

Adiantites machaneki *Stur*, p. 356 (Kidston Collection No. 2836).
Neuropteris antecedens *Stur*, p. 365 (Kidston Collection Nos. 709, 3310, 4836).

IN 'PLANT LIFE THROUGH THE AGES,' *Cambridge*, 1931.

By PROFESSOR A. C. SEWARD, SC.D., LL.D., F.R.S.

Lepidodendron nathorsti *Kidston*, text-fig. 54, A. B., p. 188 (Kidston Collection No. 56).

IN THE PROCEEDINGS OF THE ROYAL SOCIETY OF EDINBURGH, VOLUME LI.

By R. CROOKALL, PH.D.

Lyginodendron landsburgi *Gourlie*, p. 33 (Kidston Collection No. 3220).

IN MEMOIRS OF THE GEOLOGICAL SURVEY. SUMMARY OF PROGRESS OF THE GEOLOGICAL SURVEY OF GREAT BRITAIN AND THE MUSEUM OF PRACTICAL GEOLOGY FOR THE YEAR 1930. Part II.

VII.—*Petrified Plants from the Pennant Rock.*

By R. CROOKALL, PH.D.

Dadoxylon sp. (Slides Nos. J. P. 405, 406, 827; R. C. 3, 17, 18, 41, 47).

IN MEMOIRS OF THE GEOLOGICAL SURVEY. SUMMARY OF PROGRESS OF THE GEOLOGICAL SURVEY OF GREAT BRITAIN AND THE MUSEUM OF PRACTICAL GEOLOGY FOR THE YEAR 1930. Part III.

VIII.—*Correlation of the British and French Upper Coal Measures.*

BY R. CROOKALL, PH.D.

Sphenophyllum angustifolium (*Germar*), p. 63 (Kidston Collection, No. 2712).
Linopteris obliqua (*Bunbury*), p. 64 (Kidston Collection, Nos. 821, 4010, 4602).
Sigillaria brardi *Brongniart*, p. 64 (Kidston Collection, No. 818).
Asterotheca lepidorachis (*Brongniart*), p. 67 (Kidston Collection, Nos. 3845, 6072).
Asterotheca hemitelioides (*Brongniart*), p. 67 (Kidston Collection, Nos. 463, 3335, 3856).
Pecopteris bioti *Brongniart*, p. 67 (Kidston Collection, No. 2245).

IN THE PROCEEDINGS OF THE ROYAL PHYSICAL SOCIETY, VOLUME XXII.

A Critical Revision of Kidston's Coal Measure Floras.

BY R. CROOKALL, PH.D.

Sphenopteris sewardi *Kidston*, p. 25 (Kidston Collection No. 261).
Alloiopteris radstockensis *Kidston*, p. 25 (Kidston Collection No. 3826).

R. CROOKALL.

3. PETROGRAPHICAL WORK

The ordinary routine work of the Petrographical Department as far as the Survey is concerned has been as usual related to the English and Scottish districts undergoing re-survey, supplemented by duties imposed upon it by current enquiries from outside sources.

During the past year, however, the imminent removal of the collections to a new museum, and their consequent rearrangement, has placed upon the department, and the Petrographer in particular, the responsibility of reviewing and supplementing the existing collections, planning their reorganisation, and providing for their future adequate and suitable display.

In the new Museum the exhibited petrographical material will be split up in order to serve two important purposes, firstly to illustrate the broader principles of petrography, petrographical processes, and rock structure, and secondly to illustrate the petrography of restricted British areas taken in conjunction with the related stratigraphy and geological structure of the region concerned. This radical and eminently desirable change in the mode of treatment of displayed petrographical material has entailed, and will continue to entail, a large amount of curatorial work, and a close petrographical study of the existing collections. Considerable progress, however, in this work has already been made.

Amongst the enquiries of archaeological interest dealt with by the Petrographer, two may be specially mentioned. A Romano-British, beautifully carved stone said to have been found on the site of St. Martin-in-the-Fields, Trafalgar Square, and preserved by the Westminster Corporation, proved to be of Italian statuary marble (Carrara) and therefore imported material. Neolithic implements found at Nailsworth in Gloucestershire and at Windmill Hill in Wiltshire proved to be of the characteristic granophyric rock from Craigllwyd in Caernarvonshire, at which place, some years ago, Mr. Hazzledine Warren detected the site of a Neolithic stone-axe factory. Artifacts of identical material have been found in Anglesey and in Yorkshire proving a wide dispersal of implements made from the Craigllwyd rock.

HERBERT H. THOMAS.

4. CHEMICAL WORK

The quantitative analyses completed during 1931 included fourteen rocks for various Scottish memoirs, and two rocks from Persia.

905. *Gabbro.* Summit of Mains Hill, 600 yds. S.E. of Ardmillan House near Girvan. 6-inch map, Ayr, 55 S.E. Slice No. S 27366.

906. *Granite.* Summit of Byne Hill, 2¼ miles S.W. of Girvan Harbour. 6-inch map, Ayr, 55 S.W. Slice No. S 27367.

908. *Basalt.* Blocks in agglomerate, Stockingray Bay, 300 yds. N. of Pinbain Point, N.E. of Lendalfoot. 6-inch map, Ayr, 61 N.W. Slice No. S 27370.

910. *Bostonite.* Dyke cutting Old Red Sandstone. Scorrodale, Orphir. 6-inch map, Orkney, 107 S.W. Slice No. S 27536.

911. *Lamprophyre.* Dyke cutting Old Red Sandstone. Skaill Loch, Sandwick. 6-inch map, Orkney, 94 S.W. Slice No. S 27538.

912. *Monchiquite* (*nepheline-basalt*). Dyke cutting Old Red Sandstone. Crockness, Walls, Hoy. 6-inch map, Orkney, 119 S.W. Slice No. S 27539.

913. *Camptonite.* Dyke. Shore of Skaill Loch, Sandwick. 6-inch. map, Orkney, 94 S.W. Slice No. S 27537.

Lab. Nos.	905	906	908	910	911	912	913
SiO_2	45.80	70.18	47.01	49.25	46.85	38.64	43.03
Al_2O_3 ...	16.34	14.24	18.07	18.45	12.86	10.26	10.07
Fe_2O_3 ...	1.67	0.16	5.15	0.63	3.81	3.24	4.36
FeO	12.53	4.64	5.20	4.09	8.07	7.21	7.55
MgO	5.39	0.71	3.17	3.88	6.10	14.51	8.46
CaO	8.44	1.44	10.00	6.43	5.67	13.83	10.42
Na_2O... ...	3.11	6.09	3.46	3.31	4.91	2.73	2.47
K_2O	0.73	0.73	0.63	3.83	2.30	0.75	1.60
H_2O > 105°C.	2.03	0.88	1.11	3.25	2.30	3.03	1.89
H_2O < 105°C.	0.23	0.34	2.38	0.75	1.47	0.54	1.75
TiO_2	3.02	0.46	2.94	0.87	3.35	2.83	3.19
P_2O_5	0.10	0.23	0.45	0.80	0.78	1.47	0.57
MnO	—	—	0.10	—	—	0.19	—
CO_2	0.00?	0.00?	0.16	3.86	1.31	0.53	4.09
FeS_2	0.50	0.19	0.14	0.40	0.39	0.20	0.18
Cr_2O_3 ...	—	—	—	—	—	0.24	0.20
NiO, CoO ...	—	—	—	—	0.06	—	—
Totals ...	99.89	100.29	99.97	99.80	100.23	100.20	99.83
Analysed by	B. E. Dixon.						

914. *Ottrelite-schist.* Shore, Hoswick, Shetland.

915. *Picrite.* (15 fms. from top of sill). Stankard's No. 2 boring, near Uphall. 6-inch map Linlithgow, 6 S.W. Slice No. S 27983.

916. *Picroteschenite.* Sill (34 fms. 3 ft. from top of sill). Stankard's No. 2 boring, near Uphall. 6-inch map, Linlithgow, 6 S.W. Slice No. S 28003.

919. *Thomsonite rock.* Enclosure in picrite sill. Blackness No. 2 boring, at 61 fms. 1 ft. 6 in., ½ mile W. of Castle. 6-inch map, Linlithgow, 2 S.W. Slice Nos. S 27948 and S 28309.

921. *Olivine-diabase.* Sill in Carboniferous (7 fms. from top of sill). Stankard's No. 2 boring, near Uphall. 6-inch map, Linlithgow, 6 S.W. Slice No. S 27975.

Lab. Nos.	914	915	916	919	921
SiO_2	55.09	40.84	43.82	39.82	47.66
Al_2O_3	25.07	6.58	10.60	14.72	14.03
Fe_2O_3	2.97	2.59	4.36	2.21	3.13
FeO	5.78	11.61	6.88	5.28	6.04
MgO	1.53	23.72	12.77	7.30	9.65
CaO	0.30	4.46	6.75	13.32	7.74
Na_2O	1.23	0.91	3.14	2.63	2.93
K_2O	2.90	0.32	1.52	0.34	0.84
$H_2O > 105°C.$ ...	3.64	6.15	4.59	6.93	3.06
$H_2O < 105°C.$ ...	0.06	1.22	2.66	2.79	2.81
TiO_2	1.08	1.29	2.34	0.99	1.62
P_2O_5	0.19	0.21	0.48	1.01	0.27
MnO	0.16	0.21	0.17	0.22	0.16
CO_2	0.00?	0.00?	0.00?	0.53	0.00?
FeS_2	0.00?	0.06	0.22	1.72	0.10
Fe_7S_8	—	—	—	0.00?	—
Cr_2O_3	0.03	0.10	0.11	0.07	0.12
Totals	100.03	100.27	100.41	99.88	100.16
Analysed by				B. E. Dixon.	

B. E. Dixon.

IV. MUSEUM OF PRACTICAL GEOLOGY

The total attendance of visitors for the year was 19,825; of these 1,382 were Sunday visitors. Twenty-four demonstrations to parties from schools, scientific and technical institutions were given, the total attendance at these being 575.

The time of the Museum staff has been very largely devoted to the preparation of the exhibits for the new Museum at South Kensington, which is now in the later stages of structural completion. This work involves the complete reorganization of the existing displayed and reserve collections, and, to cope with it, members of the field staff have been transferred to the Museum, where they are employed on the arrangement of sectional exhibits relating to the districts with which the respective officers are familiar. Considerable progress has been made. Draft plans for the various lay-outs for the three exhibition galleries have been prepared; the appropriate specimens have been withdrawn from the existing collections and relabelled; and a certain amount of necessary collecting and photographic work has been carried out. Exhibits involving the employment of outside professional assistance have been designed and, in some cases, partially or wholly completed under the supervision of Museum and Survey officers. In view of the demands of this work on the time of the Museum staff, the geophysical field surveys, for which they have been largely responsible during the past few seasons, were suspended and the apparatus was transferred to the newly-created Department of Geophysics at the Imperial College of Science. The results obtained in the previous season were, however, worked up and published[1] during the year.

Exhibits illustrating the work of the Survey were prepared for the British Association Meeting in London, and for the Annual Conversazione of the Geologists' Association.

The increasing use to which the Library has been put in recent years by members of the general public and by students and research workers has been well maintained. The additions during the year comprise 206 volumes of independent works, 3,159 volumes and parts of serials, 149 pamphlets, 418 maps and 1,107 geological photographs; 2,950 pamphlets from the valuable Teall Collection have been incorporated. The public orders comprised 309 photographic prints and 248 lantern slides.

W. F. P. McLintock.

[1] McLintock, W. F. P. and J. Phemister, 'A Gravitational Survey over a Region of Magnetic Anomaly at Thrussington, Leicestershire,' 'Summary of Progress' for 1930, Pt. ii (*Mem. Geol. Surv.*), 1931, p. 74; 'On a Magnetic Survey over the Lornty Dyke, Blairgowrie, Perthshire,' *op. cit.*, Pt. iii, p. 24; A. F. Hallimond, 'On a Preliminary Magnetic Survey over the Pentland Fault, near Portobello, Midlothian, Scotland,' *op. cit.*, Pt. iii, p.30.

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